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THE PELAGIC COPEPODS OF THE IZU REGION, MIDDLE JAPAN SYSTEMATIC ACCOUNT VI. - FAMILIES PHAENNIDAE AND THARYBIDAE-

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THE PELAGIC COPEPODS OF THE IZU REGION, MIDDLE JAPAN
SYSTEMATIC ACCOUNT VI.¹⁾

FAMILIES PHAENNIDAE AND THARYBIDAE

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With 25 Text-figures

Family PHAENNIDAE

Genus *Phaenna* CLAUS

Phaenna spinifera CLAUS

(Fig. 81, a-b)

Phaenna spinifera GIESBRECHT, 1892, p. 293; A. SCOTT 1909, p. 80; WOLFENDEN, 1911, p. 285;
WITH, 1915, p. 54; MORI, 1937, p. 54, pl. 27, figs. 9-15; WILSON, 1950, p. 285; VERVOORT,
1950, p. 83, figs. 1-6.

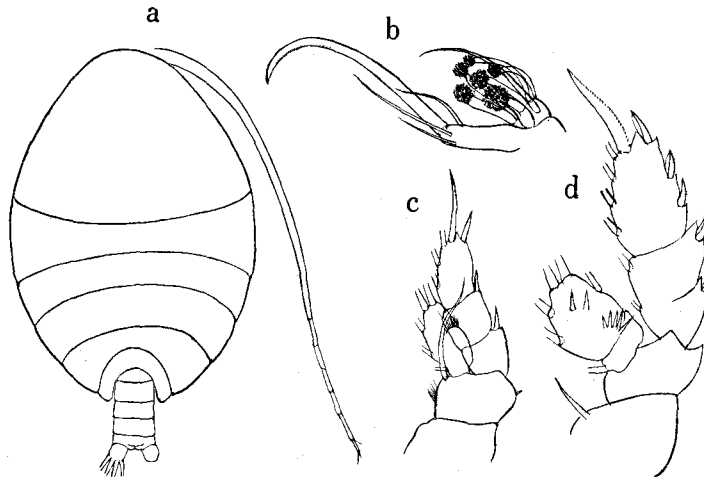


Fig. 81. *Phaenna spinifera* CLAUS.

Female juv.: a, dorsal aspect; b, distal joints of 2nd maxilla;
c, 1st leg; d, 2nd leg.

1) Part V appeared in this journal, Vol. VI, no. 3, pp. 327-367 (1958).

Immature female. Length, 1.81 mm. The cephalothorax rounded in dorsal aspect. The abdomen 4-segmented. The 1st antenna exceeds the distal end of the furca by 1 or 2 joints (fig. *a*). The mouth parts as described by GIESBRECHT (fig. *b*).

The 1st leg has 3-jointed exopodite and 1-jointed endopodite (fig. *c*). The 2nd leg has 3-jointed exopodite and 2-jointed endopodite (fig. *d*). In the 4th leg the 2nd joint of the exopodite is furnished with transverse rows of acicular spines on the posterior surface. The 5th pair of legs absent.

Occurrence. Two immature females from Sagami in the hauls from 1000 m to the surface.

Distribution. The species is widely distributed in the Atlantic, Pacific, and Indian Oceans, also from Malay Archipelago and the Mediterranean Sea. It has been also recorded from the surface water of the Pacific coast of Japan.

Genus *Xanthocalanus* GIESBRECHT

A single species of the genus, *Xanthocalanus agilis* GIESBRECHT, has been recorded from the Malayan region but no examples of the genus has been discovered from the Indian Seas and from the Japanese waters.

The genus has the following characters. The head separates from the 1st thoracic segment. The abdomen 4-segmented in the female; the anal segment and furcal rami are very short. The rostrum bifurcate, has slender filaments articulated to the basal portion. The 1st antenna of the female 24-jointed; that of the male 17-jointed on the right; 18-jointed on the left. The 2nd maxilla of the female has slender vermiform and small brush-shaped setae on the endopodite; the apical lobes have each strong curved spines coarsely denticulated on the inner margin. In the male the apical portion of the 2nd maxilla has, according to GIESBRECHT, only one large, short-stalked, and brush-shaped sensory appendage; The 5th pair of legs 3-jointed in the female, 5-jointed in the male.

The female of *Xanthocalanus* has, usually, slender sensory setae on the endopodite of the 2nd maxilla. But in some species, for example, *X. pinguis* FARRAN, one of the sensory setae is much larger than the others, and has a ciliated head. Some of the male of the genus, such as *X. greeni* FARRAN, and *X. borealis* SARS, have the 2nd maxilla furnished with a large button-like sensory appendage and several brush-shaped sensory setae on the endopodite, and the apical lobes are furnished with flexible plumose spines (cf. SARS, 1925, pl. 36, figs. 9, 10; pl. 38, fig. 9). This peculiar structure of the 2nd maxilla is also found in the female of *Amalophora* (T. SCOTT). The 1st maxilla of *Xanthocalanus* bears normal setae on the 1st inner lobe in the female but in the male of *X. greeni* FARRAN these setae are replaced by soft-skinned and fleshy ones (SARS, 1925, pl. 36, fig. 8; SEWELL, 1947, fig. 31, B). Male specimens of *Amalophora* have usually the similar

structure as found in the male of *Xanthocalanus*. These characters show a close relationship between the genera *Xanthocalanus* and *Amallophora*.

The following species of the genus have been detected in my collection: *X. pinguis* FARRAN, *X. profundus* SAKS, *X. amabilis* sp. nov., *X. legatus* sp. nov., *X. penicillatus* sp. nov., *X. medius* TANAKA, *X. echinatus* SAKS, *X. pectinatus* sp. nov.. The last two species are represented by male. It is noteworthy that these male specimens have only small sensory setae on the endopodite of the 2nd maxilla.

Xanthocalanus pinguis FARRAN

(Fig. 82, a-n)

Xanthocalanus pinguis, FARRAN, 1906, p. 39, pl. 8 and 9; FARRAN, 1908, p. 48, pl. 4; WITH, 1915, p. 236, pl. 7; SAKS, 1925, pl. 35, figs. 8-10; WILSON, 1932, p. 71, text-fig. 48, a-c; JESPERSEN, 1934, p. 82; WILSON, 1950, p. 351.

Female. Length, 5.41 mm; cephalothorax, 4.07 mm; abdomen, 1.34 mm. The cephalothorax oblong ovate. The head separates from the 1st thoracic segment; the 4th and 5th thoracic segments separate (fig. a). The lateral distal corner of the last thoracic segment triangularly produced and terminates into downwardly pointing spine (fig. c). The rostrum is composed of a pair of slender filaments directing downward (figs. b, d).

The abdominal segments and furca in the proportional lengths 42:23:13:11:11=100. The genital segment not swollen below; there is a tuft of short hairs near the genital opening when viewed from the lateral; the dorsal surface of the segment haired near the proximal. The first 3 segments are covered with small spines, the distal margin of the segments are fringed with fine teeth. The furcal ramia little wider than long (8:7).

The 1st antenna 24-jointed, extends to the distal end of the 4th thoracic segment; the joints are in the following proportions:

Joint	1	2	3	4	5	6	7	8-9	10	11	12	13	14
	77	82	37	35	35	32	28	39	28	28	32	41	41
	15	16	17	18	19	20	21	22	23	24	25		
	53	53	53	48	41	37	32	30	44	46	27	=1000.	

The 2nd antenna with the exopodite slightly longer than the endopodite (13:12). The mandible with the exopodite about as long as the endopodite; the 2nd basal joint has 3 long inner marginal setae. The 1st maxilla has an elongate endopodite; the outer lobe has 9 setae; the endopodite has 9 setae (fig. e). The 2nd maxilla has 7 bud-like, and one long worm-like sensory filaments on the endopodite; the curved spine of the 5th lobe very strong (fig. f). The maxilliped has robust basal joints (fig. g).

The 1st leg has 3-jointed exopodite and 1-jointed endopodite (fig. *h*). The 2nd leg has 3-jointed exopodite and 2-jointed endopodite; the 2nd joint of the endopodite has 2 groups of spinules on the posterior surface; the terminal spine of the exopodite has about 40 serrations (fig. *i*). The 3rd and 4th legs with 3-jointed exopodite and endopodite; the posterior surface of the endopodite has groups of spinules as shown in the figure (figs. *j*, *k*).

The 5th pair of legs 3-jointed. The terminal joint broad, has 4 spines; the

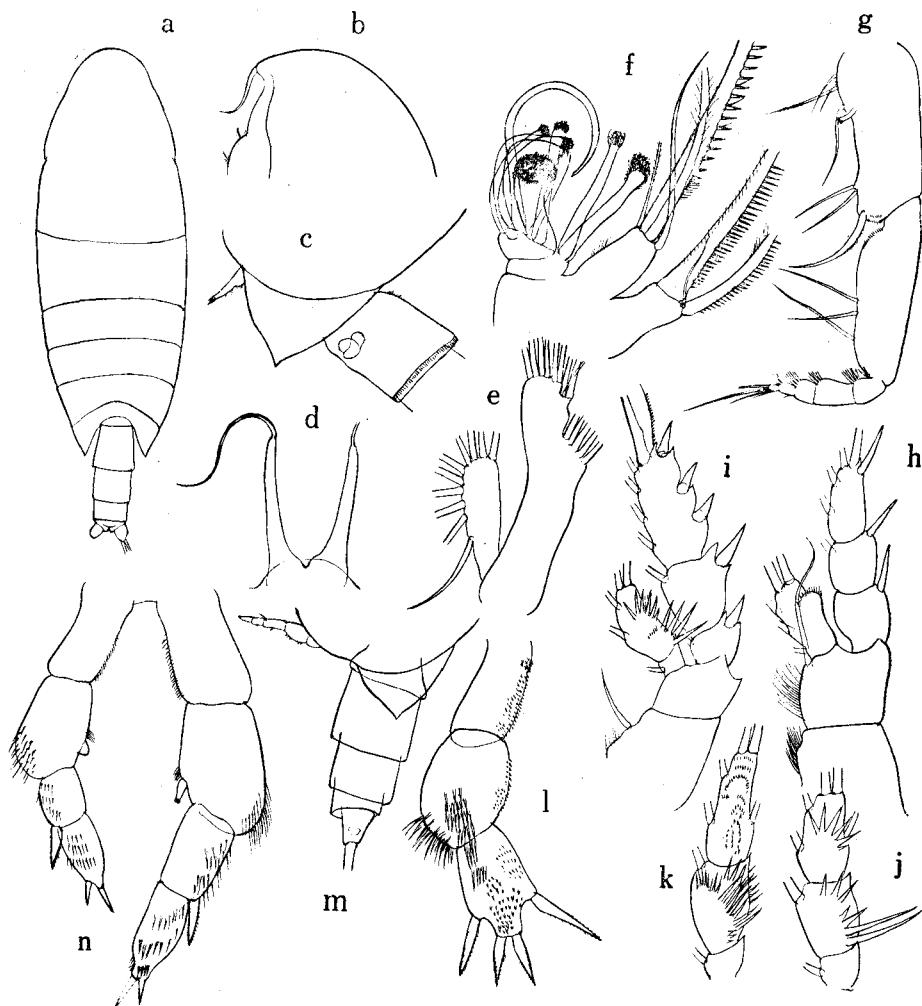


Fig. 82. *Xanthocalanus pinguis* FARRAN.

Female: *a*, dorsal aspect; *b*, head, lateral aspect; *c*, last thoracic segment and genital segment, lateral aspect; *d*, rostrum; *e*, exopodite and endopodite of 1st maxilla; *f*, 2nd maxilla; *g*, maxillipede; *h*, 1st leg; *i*, 2nd leg; *j*, endopodite of 3rd leg; *k*, endopodite of 4th leg; *l*, 5th leg. Immature male: *m*, thoracic segments and abdomen, lateral aspect; *n*, 5th pair of legs.

posterior surface of the joint is furnished with minute spines on the distal part; the inner margin of the joint bears several groups of spinules. The 2nd joint is rounded in shape, and furnished with long acicular spines on the distal outer margin; the inner margin of the joint bears several rows of minute spinules. The 1st joint is furnished with several rows of spinules on the inner margin (fig. 1).

Immature male. Length, 4.33 mm. General appearance as in the female. The abdomen 4-segmented (fig. m). The abdomen is contained 3.6 times in the length of the cephalothorax. The 1st antenna extends to the posterior margin of the cephalothorax. The mouth parts and swimming legs as in the female. The 5th pair of legs 4-jointed, and asymmetrical; the left leg longer; the 2nd basal joint has each a rudimentary endopodite (fig. n).

Remarks. The specimen agrees fairly well with *X. pinguis* FARRAN except a slight difference in the shape of the 5th thoracic segment, and in the proportional lengths of the joints of the 1st antenna. In 1908 FARRAN described an example of *X. pinguis* which has the 5th pair of legs slightly differ from that originally described in 1906. WITH regarded both specimens as identical. FARRAN showed four different forms of the 5th pair of legs (pl. VIII, figs. 14-17); the number of the spines on the distal joint is variable. FARRAN's specimen measured 4.5 mm and 5.1 mm; WITH's 5.19 mm; SARS' 7.3 mm.

Occurrence. Two adult females and an immature male were collected from Sagami and Suruga Bays in the vertical hauls 1000-0 m.

Distribution. The species has been recorded from the North Atlantic and Pacific Oceans.

Xanthocalanus profundus SARS ?

(Fig. 83, a-e)

Xanthocalanus profundus, SARS, 1925, p. 125, pl. 34, figs. 1-15.

Female. Length 4.69 mm: cephalothorax 3.53 mm; abdomen, 1.06 mm. General appearance as in the female of *Xanthocalanus pinguis* FARRAN (fig. a). The abdominal segments and furca in the proportional lengths 38:23:17:11:11=100. The furcal rami slightly wider than long.

The 1st antenna extends to the distal end of the 4th thoracic segment. The 2nd antenna with the exopodite a little longer than the endopodite (8:7). The mandible, maxillae, and maxillipede as those of *X. pinguis*.

The 1st leg has no characteristic features. The 2nd to 4th legs as those of *X. pinguis* except slight differences in the number of the spines on the posterior surface of the endopodite (figs. b, c, d).

The 5th pair of legs 3-jointed; the distal 2 joints are fused. The terminal joint slender, and bears 4 spines; the posterior surface of the joint is furnished

with a longitudinal row of small spines. The 2nd joint is furnished with hair-like spines on the outer distal margin; the posterior surface of the joint is furnished with scattered denticles near the outer distal margin. The 1st joint finely denticulated on the inner margin (fig. *e*).

Remarks. The specimen closely resembles *X. pinguis* but the 5th pair of legs is different from that of *X. pinguis* in having elongated 3rd joint, and in having no trace of demarcation between the 1st and 2nd joints of the 5th pair of legs. The present specimen could possibly be an example of *X. pinguis* FARRAN which has deformed 5th pair of legs as had been pointed out by FARRAN.

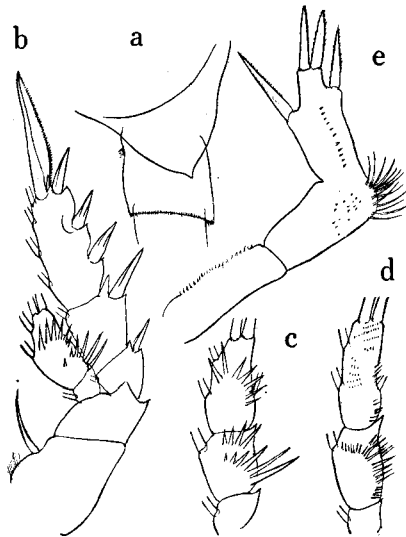


Fig. 83. *Xanthocalanus profundus* Sars?
Female: *a*, last thoracic segment and genital segment, lateral aspect; *b*, 2nd leg; *c*, endopodite of 3rd leg; *d*, endopodite of 4th leg; *e*, 5th leg.

Occurrence. A single female was collected in Sagami Bay from the depth 1000 m.

Distribution. *Xanthocalanus profundus* has been recorded from the subtropical region of the Atlantic.

Xanthocalanus amabilis sp. nov.

(Fig. 84, *a-i*)

Female. Length, 2.66 mm: cephalothorax, 2.04 mm; abdomen, 0.62 mm. The cephalothorax oblong ovate. The head separates from the 1st thoracic segment;

the frontal margin rounded (fig. *b*). The 4th thoracic segment separates from the 5th (fig. *a*). The lateral distal corner of the last thoracic segment produced into a small pointed tooth (fig. *c*). The rostrum terminates into 2 filaments as shown in the figure (fig. *e*).

The abdominal segments and furca in the proportions 37:26:17:6:14=100. The genital segment a little longer than wide (14:13); the ventral surface of the segment sinuate; the genital area large (fig. *d*). The first 3 segments are furnished with fine teeth on the distal margin. The furcal rami longer than wide (5:4).

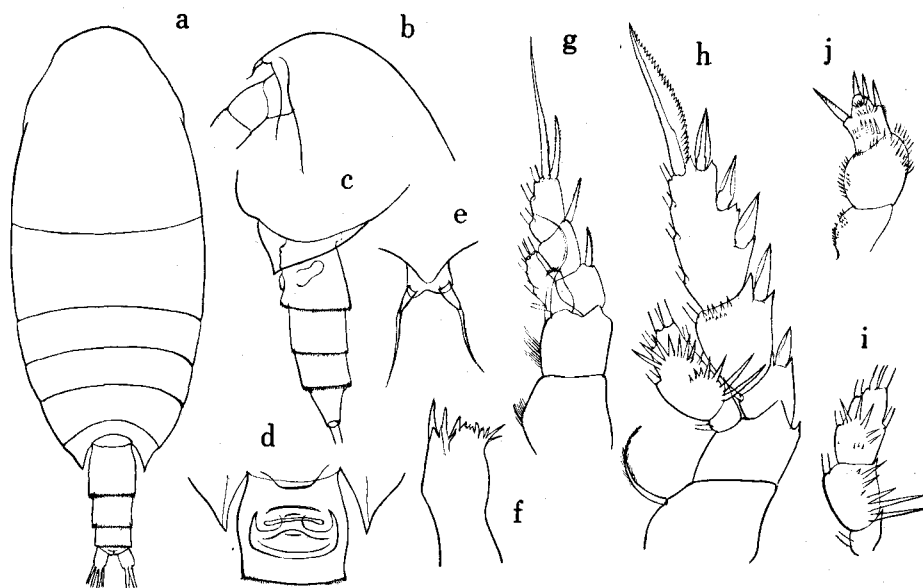


Fig. 84. *Xanthocalanus amabilis* sp. nov.

Female: *a*, dorsal aspect; *b*, head, lateral aspect; *c*, last thoracic segment and abdomen, lateral aspect; *d*, genital segment, ventral aspect; *e*, rostrum, anterior aspect; *f*, cutting blade of mandible; *g*, 1st leg; *h*, 2nd leg; *i*, endopodite of 3rd leg; *j*, 5th leg.

The 1st antenna reaches back to the distal margin of the 2nd abdominal segment; the joints are in the following proportions:

Joint	1	2	3	4	5	6	7	8-9	10	11	12	13	14
	60	69	33	29	29	33	33	52	29	33	36	40	44
	15	16	17	18	19	20	21	22	23	24	25		
	48	52	53	44	40	36	32	32	52	60	32=1000.		

The 2nd antenna with the exopodite 1.3 times as long as the endopodite (41:31). The mandible with the exopodite as long as the endopodite; the biting part with slender teeth (fig. *f*). The 1st maxilla with 9 setae on the outer lobe,

10 setae on the exopodite, 4+2+2 setae on the endopodite, 5 setae on the 2nd basal joint. The 2nd maxilla is of a usual structure found in the female of the genus. The maxillipede has the joints of the following proportions: 400:367:55:78:45:33:22=1000.

The 1st leg has a long outer edge spine on the 3rd joint of the exopodite (fig. *g*). The 2nd leg has 3-jointed exopodite and 2-jointed endopodite; the 2nd joint of the exopodite has transverse rows of spinules on the distal margin; the 2nd joint of endopodite is furnished with 2 groups of spinules on the posterior surface; the terminal spine of the exopodite has 32 teeth (fig. *h*). The 3rd leg with 3-jointed exopodite and endopodite; the 2nd and 3rd joints of the endopodite have each groups of spinules on the posterior surface (fig. *i*); the terminal spine of the exopodite has 32 teeth. In the 4th leg the 2nd joint of the endopodite has rows of fine spinules on the posterior surface.

The 5th pair of legs 3-jointed; it is short and tumid. The 1st joint is slightly longer than wide, and has groups of spinule on the inner margin. The 2nd joint swollen, about as long as wide, bears short spinules on the inner margin, and longer ones on the outer distal half of the joint; these spinules are more densely furnished on the anterior surface. The 3rd joint has 4 marginal spines of which the inner one the longest; the joint is furnished with groups of spinules on the anterior surface (fig. *j*).

Remarks. The specimen resembles *X. obtusus* FARRAN in the structure of the 5th pair of legs, but the lateral distal margin of the last thoracic segment is obtusely rounded in *obtusum*, whereas, it is sharply pointed at the apex in the present species. The specimen is also closely related to *X. fallax* SARS in general appearance, but can be distinguished from it by the shape of the 5th pair of legs which have swollen 2nd joint; in *fallax* the 1st joint of the 5th pair of legs is the largest and swollen along the inner margin.

Occurrence. One female from Sagami Bay, in the haul 1000-0 m, October, 1938.

Xanthocalanus legatus sp. nov.

(Fig. 85, *a-j*)

Female. Length, 2.60 mm: cephalothorax, 2.05 mm; abdomen, 0.55 mm. The cephalothorax ovate in outline. The head fused with the 1st thoracic segment. The 4th thoracic segment incompletely fused with the 5th; the line of demarcation faintly visible in dorsal view (fig. *a*). The lateral distal margin of the last thoracic segment produced triangularly into a sharp point (fig. *c*). The rostrum strong in the basal part, to which 2 slender filaments are attached (figs. *b, d*).

The abdominal segments and furca in the proportional lengths 40:22:16:9:13=100. The genital segment, when viewed from the dorsal, inflated toward the

distal end; the genital area hollowed. The first 3 segments are fringed with fine teeth on the distal margin. The furcal rami oblique, about as long as wide.

The 1st antenna 24-jointed reaches back to the distal end of the 2nd abdominal segment; the joints are in the following proportions:

Joint	1	2	3	4	5	6	7	8-9	10	11	12	13	14
	52	61	30	30	30	30	30	52	27	30	38	42	46
	15	16	17	18	19	20	21	22	23	24	25		
	50	57	52	52	46	38	38	34	52	52	38=1000.		

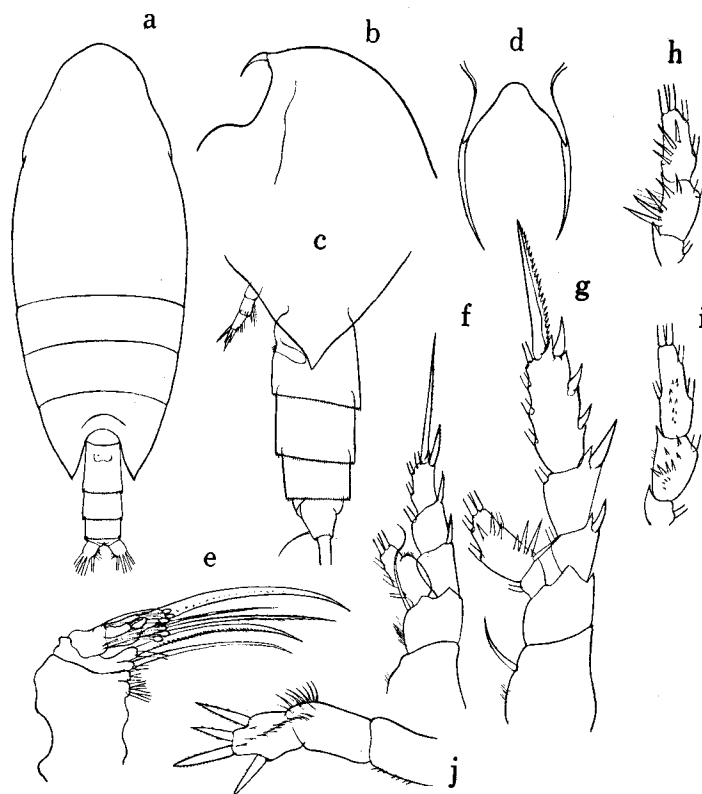


Fig. 85. *Xanthocalanus legatus* sp. nov.

Female: *a*, dorsal aspect; *b*, head, lateral aspect; *c*, last thoracic segment and abdomen, lateral aspect; *d*, rostrum, anterior aspect; *e*, 2nd maxilla; *f*, 1st leg; *g*, 2nd leg; *h*, endopodite of 3rd leg; *i*, endopodite of 4th leg; *j*, 5th leg.

The 2nd antenna with the exopodite longer than the endopodite (33:24). The mouth parts resemble those of *X. pinguis* FARRAN. The 1st maxilla has 9 setae on the outer lobe, 10 setae on the exopodite, 3+2+2 setae on the endopodite, 5 setae on the 2nd basal joint. The 2nd maxilla feeble, the endopodite bears small bud-like sensory setae (fig. *e*).

The 1st leg has 3-jointed exopodite and 1-jointed endopodite, and has no characteristic features (fig. *f*). In the 2nd leg the 2nd joint of the endopodite has 2 groups of spinule on the posterior surface; the terminal spine of the exopodite has 23 teeth (fig. *g*). The endopodite of the 3rd and 4th legs as figured (figs. *h, i*).

The 5th pair of legs 3-jointed; these 3 joints are of about equal width (fig. *j*). The 2nd joint 2 times as long as wide, bears hair-like spines on the anterior distal margin, and scattered spinules near the posterior distal margin. The 3rd joint has 2 apical and 2 marginal spines, and bears a longitudinal row of short spines on the posterior surface. The 1st joint bears denticles on the inner margin.

Remarks. The present specimen is closely allied to *X. pinguis* FARRAN, and has the following characteristics which separate it from *X. pinguis*: much smaller in size; inflated cephalothorax and incomplete segmentation of the 4th from the 5th thoracic segment; some minute points of difference in the structure of the 5th pair of legs.

Occurrence. One female from Suruga Bay in the haul 1000-0 m, November, 1938.

Xanthocalanus penicillatus sp. nov.

(Fig. 86, *a-l*)

Female. Length, 3.53 mm: cephalothorax, 2.66 mm; abdomen, 0.87 mm. The cephalothorax oblong ovate. The head separates from the 1st thoracic segment; the last 2 thoracic segments are fused (fig. *a*). The lateral distal corner of the last thoracic segment is produced triangularly with a point at the apex (fig. *c*). The rostrum ends into 2 fine filaments; the basal part slightly swollen in lateral aspect (figs. *b, d*).

The abdominal segments and furca in the proportional lengths 37:29:16:8:10=100. The genital segment as long as wide, inflated toward the distal end. The first 3 segment are furnished with scattered spinules; the distal margin of the joints smooth. The furcal rami as long as wide.

The 1st antenna 24-jointed, extends to the distal margin of the 5th thoracic segment; the joints are in the following proportions:

Joint	1	2	3	4	5	6	7	8-9	10	11	12	13	14
	73	73	32	32	32	26	29	44	25	29	32	42	42
	15	16	17	18	19	20	21	22	23	24	25		
	50	54	54	50	42	42	35	32	48	50	29=1000.		

The 2nd antenna with the exopodite slightly longer than the endopodite (22:20); the distal joint of the endopodite has 6+6 setae. The mandible with the exopodite as long as the endopodite. The 1st maxilla as in *X. pinguis* FARRAN;

the outer lobe has 9 setae, the exopodite has 10 setae, the endopodite has 5+3+3 setae; the 2nd basal has 5 setae, the 3rd inner lobe has 4 setae, the 2nd inner lobe has 5 setae, the 1st inner lobe has 13 setae (fig. *e*). The 2nd maxilla as in *X. pinguis*, carries both bud-like and vermiform setae on the endopodite (fig. *f*). The maxillipede has the basal joints of about equal lengths; the joints of the endopodite short (fig. *g*).

The 1st leg with 3-jointed exopodite and 1-jointed endopodite; the outer edge

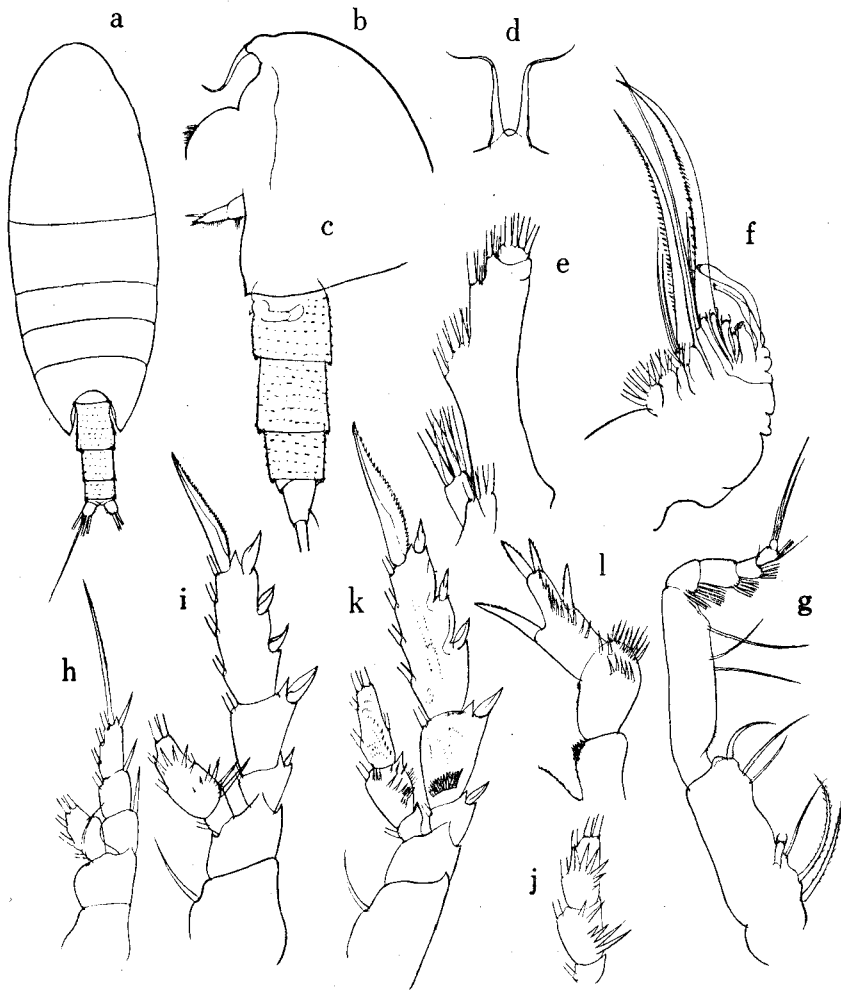


Fig. 86. *Xanthocalanus penicillatus* sp. nov.

Female: *a*, dorsal aspect; *b*, head, lateral aspect; *c*, last thoracic segment and abdomen, lateral aspect; *d*, rostrum, anterior aspect; *e*, endopodite of 1st maxilla; *f*, 2nd maxilla; *g*, maxillipede; *h*, 1st leg; *i*, 2nd leg; *j*, endopodite of 3rd leg; *k*, 4th leg; *l*, 5th leg.

spine of the 1st joint of the exopodite reaches the distal margin of the 2nd joint of the exopodite (fig. *h*). The 2nd leg with 3-jointed exopodite and 2-jointed endopodite; the 2nd joint of the endopodite has 2 groups of spines on the posterior surface; the terminal spine of the exopodite has 28 teeth (fig. *i*). The 3rd leg with 3-jointed exopodite and endopodite; the 2nd and 3rd joints of the endopodite has groups of spinules as shown in the figure (fig. *j*); the terminal spine of the exopodite has 28 teeth. The 4th leg with 3-jointed exopodite and endopodite; the 2nd and 3rd joints of the endopodite are furnished with groups of minute spinules on the posterior surface; the 2nd joint of the exopodite has a transverse row of acicular spines; the terminal spine of the exopodite has 29 serrations (fig. *k*).

The 5th pair of legs 3-jointed; the 3rd joint narrow in the distal half, carries 4 spines, of which the inner marginal one the longest; the joint has a longitudinal row of spinules on the posterior surface; the 2nd joint has groups of spines on the posterior as well as on the anterior surface; the 1st joint has denticles on the inner distal margin (fig. *l*).

Remarks. The specimen resembles closely *X. profundus* Sars, but is distinguished from it by the followings: small in size; complete fusion of the 4th thoracic segment with the 5th; scattered spinules on the 1st to 3rd abdominal segments; the shape of the 5th pair legs.

Occurrence. One female from Suruga in the haul 1000-0 m, November, 1938.

Xanthocalanus medius TANAKA

(Fig. 87, *a-g*)

Xanthocalanus media TANAKA, 1937, p. 258, pl. 17, fig. 1-10; BRODSKY, 1950, p. 231, fig. 143.

Female. Length, 3.30 m: cephalothorax, 2.55 mm; abdomen, 0.75 mm. The cephalothorax robust. The head separates from the 1st thoracic segment; the 4th thoracic segment fused with the 5th (fig. *a*). The lateral distal margin of the last thoracic segment produced triangularly with a point at the apex, when viewed from the dorsal (fig. *c*). The rostrum bifurcate without any slender filaments at the apex (fig. *b, d*).

The abdominal segments and furca in the proportional lengths 35:25:19:2:19=100. The genital segment bears on the middorsal line a rounded lamellous plate and a slender spine when viewed from the lateral. The first 3 segments are covered with scattered spinules; the distal margin of the segments are furnished with fine teeth. The anal segment haired on the dorsal as well as on the ventral surface (fig. *c*).

The 1st antenna 24-jointed, extends to the distal margin of the genital segment; aesthetascs on the joint 2, 3, 5, 8, 12, 14 and 19. The 2nd antenna with the exopodite a little longer than the endopodite. The maxilla has 8 sensory setae

on the endopodite, of which 7 are bud-like and one is long and vermiform (fig. *e*). The maxillipede as in *X. pinguis* FARRAN.

The 5th pair legs resembles that of *X. pinguis*. The line of demarcation between the 2nd and 3rd joints undetectable; the posterior surface of the joints are furnished with spinules as shown in the figure; the inner margin of the 2nd joint carries 2 groups of poor denticles (fig. *g*).

Occurrence. One female from Suruga Bay in the vertical haul 500–250 m, June, 1936.

Distribution. Pacific coast of Middle Japan; Far-Eastern and Polar Seas of the U.S.S.R.

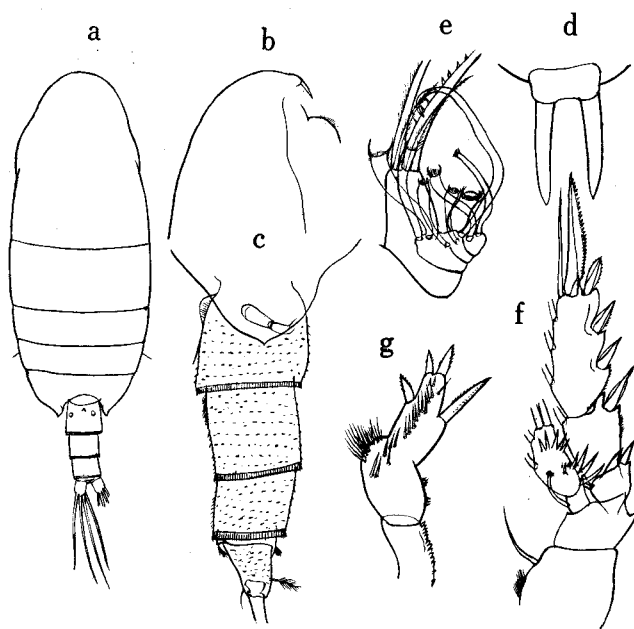


Fig. 87. *Xanthocalanus medius* TANAKA.

Female: *a*, dorsal aspect; *b*, head, lateral aspect; *c*, last thoracic segment and abdomen, lateral aspect; *d*, rostrum, anterior aspect; *e*, distal joints of 2nd maxilla; *f*, 2nd leg; *g*, 5th leg.

Xanthocalanus echinatus SARS

(Fig. 88, *a-k*)

Xanthocalanus echinatus, G. O. SARS, 1925, p. 135, pl. 37 (female).

Male. Length, 1.75 mm: cephalothorax, 1.28 mm; abdomen, 0.47 mm. The cephalothorax oblong ovate; the oral part slightly inflated in dorsal aspect. The head fused with the 1st thoracic segment. The last 2 segments are separate.

The 5th thoracic segment short, and truncated in dorsal aspect; the lateral distal corner of the segment slightly produced when viewed from the side (figs. *a, c*). The rostrum has a wide base to which 2 slender filaments are attached (fig. *d*).

The abdominal segments and furca in the proportions 16:24:24:20:4:12=100. The furcal rami parallel, longer than wide.

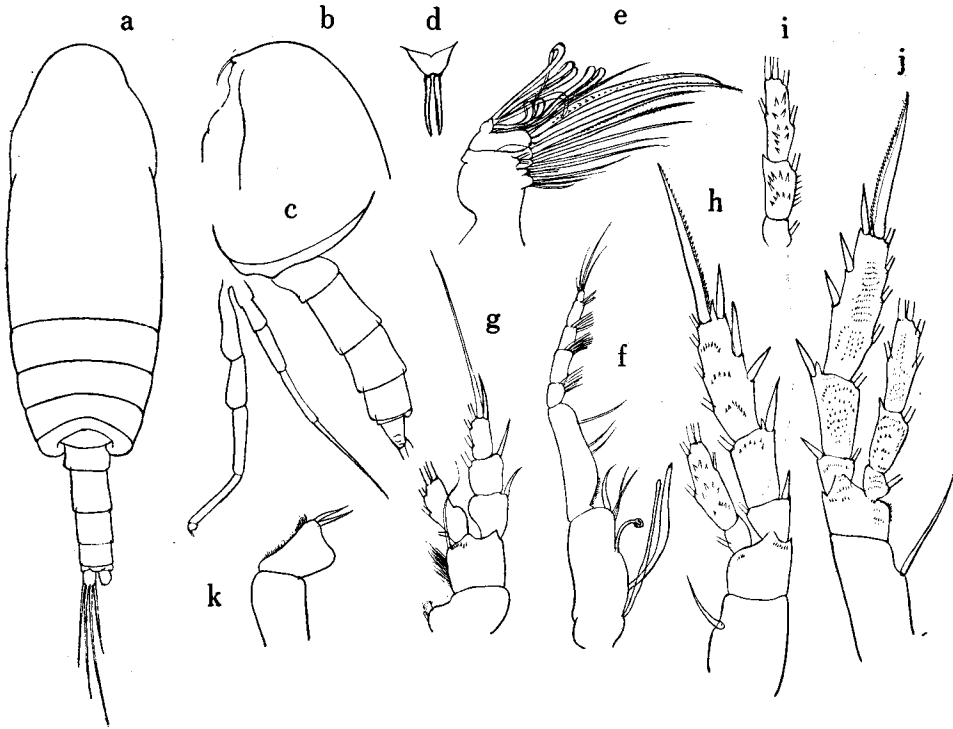


Fig. 88. *Xanthocalanus echinatus* Sars.

Male: *a*, dorsal aspect; *b*, head, lateral aspect; *c*, last thoracic segment and abdomen, lateral aspect; *d*, rostrum, anterior aspect; *e*, 2nd maxilla; *f*, maxillipede; *g*, 1st leg; *h*, 2nd leg; *i*, endopodite of 3rd leg; *j*, 4th leg; *k*, distal joint of left 5th leg.

The 1st antenna reaches back to the distal margin of the 2nd abdominal segment; the joints 8-9-10-11-12, and 13-14 are fused; the joints 20-21 are fused on the right side; the proportional lengths of the joints as follows:

Joint	1	2	3	4	5	6	7	8-9-10-11-12	13-14
	56	39	22	27	34	39	45	170	67
	15	16	17	18	19	20	21	22	23
	39	50	50	50	45	39	34	56	56
								56	56
									28=1000.

The 2nd antenna and mandible have no characteristic features. The 1st maxilla has 7 long and 2 short setae on the outer lobe, 5 setae on the exopodite, 7 setae on the endopodite, 5 setae on the 2nd basal joint. The 2nd maxilla has a denticulated spine on the 5th lobe; the distal joint of the endopodite have long vermiform setae (fig. *e*). The maxillipede slender; the 1st basal joint has 2 long vermiform filaments and a short bud-like filament (fig. *f*).

The 1st leg has 3-jointed exopodite and 1-jointed endopodite; the 2nd basal joint has a row of spinules on the inner distal corner near the base of the endopodite (fig. *g*). The 2nd leg has 3-jointed exopodite and 2-jointed endopodite; the posterior surface of the 2nd joint of the endopodite are furnished with groups of spinules; the terminal spine of the exopodite has 33 teeth; the 2nd and 3rd joints of the exopodite bear rows of spinules on the posterior surface (fig. *h*). The 3rd and 4th legs have each 3-jointed exopodite and endopodite; the posterior surface of the 2nd and 3rd joints of both the exopodite and endopodite are furnished with groups of spinules. In the 4th leg the terminal spine of the exopodite has 35 serrations; the posterior surface of the 1st to 3rd joints of the exopodite and endopodite are furnished with very minute spinules (fig. *j*). The outer marginal spines on the 2nd and 3rd joints of the exopodite of the 2nd to 4th legs are slender and long; the 2nd basal joint of the same legs are also furnished with minute spinules on the posterior surface.

The 5th pair of legs slender, and composed of 5 joints on each side (fig. *c*); the distal joint of the right leg is slender and long; the terminal joint of the left leg short, and truncated at the distal margin which is furnished with 2 apical spines of equal lengths, and short hairs on the outer margin (fig. *k*).

Remarks. The specimen agrees well with the female of *X. echinatus* Sars in its small size, in the structure of the mouth appendages, and also in having similar arrangement of spinules on the posterior surface of the joints of the exopodite and endopodite of 2nd to 4th legs. The 5th pair of legs resembles those of *Xanthocalanus* sp. described by FARRAN in 1906 or those of *X. borealis* Sars (Sars, 1925, pl. 38, fig. 7), but the distal joint of the left leg is quite different from that figured by FARRAN. Sars' female specimen *X. echinatus* measured 2.10 mm in total length.

Occurrence. One male from Suruga Bay in the haul from 1000-0 m, November, 1938.

Distribution. *X. echinatus* has only been recorded from the Atlantic near Azores.

Xanthocalanus pectinatus sp. nov.

(Fig. 89, *a-l*)

Male. Length, 5.35 mm: cephalothorax, 3.87; abdomen, 1.48 mm. The cephalo-

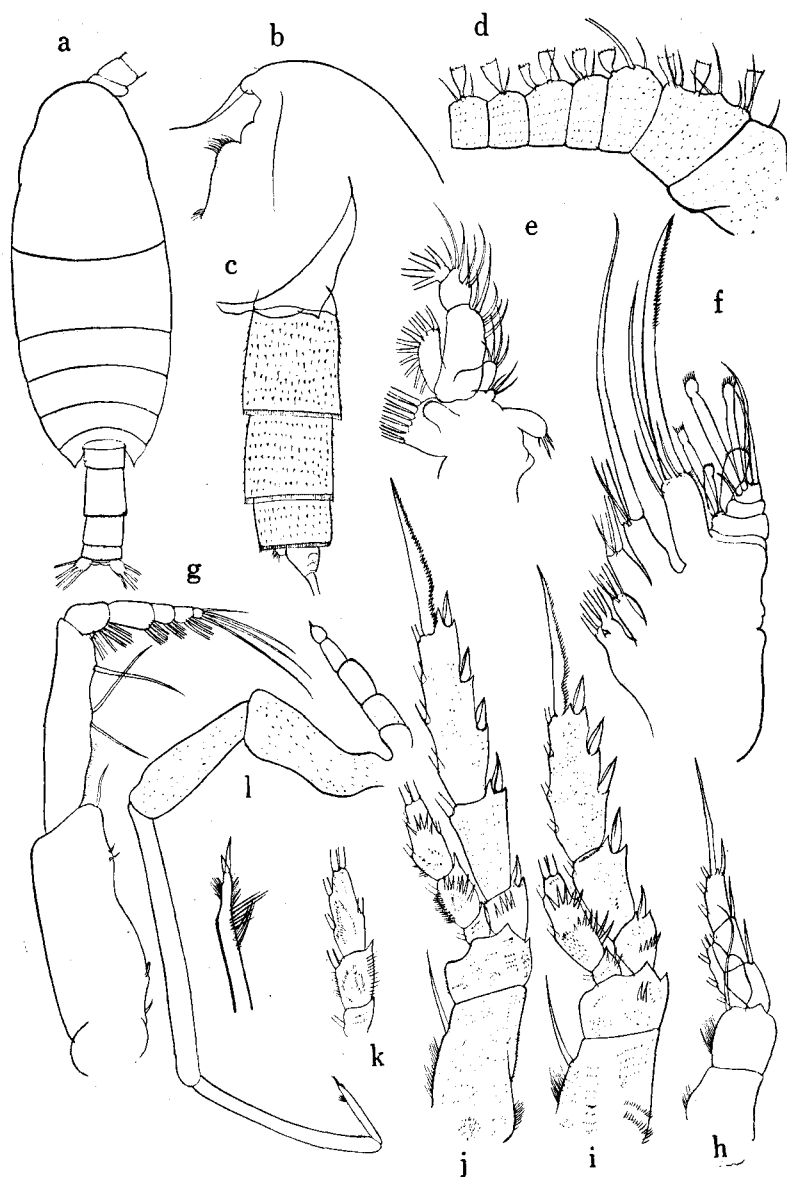


Fig. 89. *Xanthocalanus pectinatus* sp. nov.

Male: *a*, dorsal aspect, *b*, head, lateral aspect; *c*, last thoracic segment and abdomen, lateral aspect; *d*, distal joints of 1st and proximal joints of 1st antenna; *e*, 1st maxilla; *f*, 2nd maxilla; *g*, maxillipede; *h*, 1st leg; *i*, 2nd leg; *j*, 3rd leg; *k*, endopodite of 4th leg; *l*, 5th pair of legs and distal joint of left leg.

thorax elongate ovate. The head is separated from the 1st thoracic segment, so are the 4th from the 5th. The distal margin of the last thoracic segment, when viewed from the dorsal, produced on each side into a sharp tooth; the ventro-lateral margin sinuate (figs. *a*, *c*). The rostrum bifurcate, gradually attenuates, and suddenly terminates into 2 fine filaments (fig. *b*). The cephalothorax is covered with minute spinules

The abdominal segments and furca in the proportional lengths 16:33:22:14:5:10=100; the 2nd to 4th segments are covered with minute spinules. The furcal rami as long as wide.

The 1st antenna 22-jointed, extends about to the middle of the 3rd abdominal segment; the joints 20-21 are fused on the right side, but incompletely separate on the left; the joints 1 to 8 are furnished with minute spinules on the anterior surface (fig. *d*). The left antenna has the joints in the following proportional lengths:

Joint	1	2	3	4	5	6	7	8-9-10	11	12	14	14
	51	37	18	22	26	26	22	100	29	33	33	37
	15	16	17	18	19	20	21	22	23	24	25	
	55	59	62	66	62	51	44	37	55	55	26=1000.	

The 2nd antenna well developed; the exopodite 1.3 times as long as the endopodite. The mandible with a large 2nd basal joint; the exopodite as long as the endopodite; the biting part feeble. The 1st maxilla slightly reduced; the spines on the 1st inner lobe much reduced; there is a conical process near the distal part of the outer lobe which carries 7 setae; the exopodite has 10 setae; the endopodite has 4+3+3 setae; the 2nd basal carries 5 setae (fig. *e*). The 2nd maxilla reduced and soft-skinned; the endopodite has 3 usual and 5 bud-like sensory setae (fig. *f*). The maxillipede with a large 1st basal joint which is about as long as the 2nd basal; the spinulation on the inner margin of the 1st basal joint is poor (fig. *g*).

The 1st leg as usual; the outer edge spine of the joints of the exopodite long (fig. *h*). In the 2nd leg the 1st basal has 2 oblique rows of spines on the proximal outer margin; the 1st and 2nd basal joints are covered with fine spinules on the posterior surface; the 1st joint of the exopodite bears a row of spines; the 1st and 2nd joints of the endopodite are furnished with groups of spines on the posterior surface; the joints of both exopodite are, beside these rows of spines, covered with minute spinules on the posterior surface; the terminal spine of the exopodite has 43 teeth (fig. *i*). The 3rd leg has 3-jointed exopodite and endopodite, and has the similar appearance as in the 2nd leg, but the 1st joint of endopodite has no remarkable spines on the outer margin; the terminal spine of the exopodite has 31 teeth (fig. *j*). The 4th leg has the endopodite more finely spinulated (fig. *k*).

The 5th pair of legs 5-jointed on each side. The left leg very long, about

1.5 times as long as the combined lengths of the abdominal segments and furca; the terminal joint has 2 apical spines, of which one is longer; the inner margin of the joint is furnished with long coarse hairs near the distal end. The right leg short, extending only to the distal margin of the 1st joint of the left leg; the distal joint pointed at the apex (fig. 1).

Remarks. The specimen is characteristic in having the 2nd to 4th legs covered with minute spinules on the posterior surface of the joints of both exopodite and endopodite. The 5th pair of legs differs from those hitherto been described males of the genus *Xanthocalanus*.

Occurrence. One male from Suruga Bay in the haul 1000-0 m, November, 1938.

Genus *Brachycalanus* FARRAN

The genus was created by FARRAN to accomodate the species which allies closely to *Xantnocalanus* differing from the latter by the structure of the rostrum and the spines on the apical lobes of the 2nd maxilla. The genus was represented by a single species *Brachycalanus gigas* A. SCOTT collected in the "Siboga" Expedition. Up to the present time no example of the genus has been found in my collection. The genus *Brachycalanus* has the 2nd maxilla which comes near in structure to those of the genus *Lophothrix* GIESBRECHT, one of the genera of the family Scolecithricidae. *B. gigas* described by A. SCOTT is an immature male in the copepodite stage V. The species is also closely allied to *Xanthocalanus* in having the 5th pair of legs similar in structure to that of the immature male of *Xanthocalanus pinguis* FARRAN which has the 5th pair of legs composed of 4 joints as shown in the figure. The 5th pairs of legs of both species have each an rudimentary endopodite on the 2nd joint, an outer marginal spine on the 3rd joint, and a apical spine on the 4th joint.

Genus *Amallophora* T. SCOTT

The genus *Amallophora* was established by T. SCOTT in 1894 and afterwards transferred to *Xanthocalanus* by GIESBRECHT and SCHMEIL. FARRAN described the female of *A. typica* under the name *Xanthocalanus typicus* in 1908. A. SCOTT again redescribed *Amallophora* with the description of the male of *A. typica*. SARS (1925) has described the female of *A. typica* from the Atlantic. The 2nd species of the genus, *A. altera* has been described by FARRAN (1929) in the "Terra Nova" Expedition. But the species appears to remain some doubt in regarding it as a true member of the genus *Amallophora*, though the specimen has a 5th pair of legs similar in structure to that of *A. typica* A. SCOTT.

Amallophora has, according to A. SCOTT, the following characters. The rostrum bifurcate; the rami are drawn into slender filaments, but without any

trace of an articulation. In the 2nd maxilla the apical lobes are furnished with large flexible, densely plumose setae; the sensory apparatus is represented by one very large and short-stalked appendage with a densely ciliated head. The 5th pair of legs of the female 3-jointed, and that of the male 5-jointed. The exopodite of the male left 5th leg is long and slender; the right leg is short and rudimentary.

The main differences between *Xanthocalanus* and *Amallophora* are confined to the following: 1) the structure of the rostrum; 2) the structure of the apical portion of the 2nd maxilla; 3) the structure of the 5th pair of legs. The 2nd character emphasized by A. SCOTT is the presence of a single large sensory appendage on the endopodite of the 2nd maxilla. FARRAN called attention to the fact that there are, beside a single large sensory appendage, about 5 slender brush-shaped setae on the apex of the 2nd maxilla. These setae are illustrated in SARS' figure (SARS, 1925, pl. 38, fig. 13).

There are other characters which distinguish the genus from *Xanthocalanus*. In the female of *Amallophora* the lateral distal corner of the last thoracic segment is not pointed, whereas, it is sharply pointed at the apex in *Xanthocalanus*. The female 5th pairs of legs are 3-jointed in both *Amallophora* and *Xanthocalanus*, but the distal joint of the leg is furnished with 2 spines in *Amallophora*, and 3 or 4 spines in *Xanthocalanus*; the surfaces of the joint are naked in *Amallophora*, whereas, it is furnished with denticles in *Xanthocalanus*. The 1st maxilla of the female of *Amallophora* has on the 1st inner lobe of the usual slender setae on the inner margin. But these setae are deformed in most cases in the male.

In my collection there occurred 7 males closely allied to *Xanthocalanus* or to *Amallophora*. Two of them are, without doubt, the male of *Xanthocalanus*, and the remainings are to be preferably included in *Amallophora*. These 2 species of *Xanthocalanus* have, as previously mentioned, the same structure in the 2nd maxilla just as found in the female; that is, the apical lobes have coarsely serrated strong spines, and the endopodite has only small sensory setae without any large button-shaped sensory appendage.

The remaining 5 species have almost the same structure in the 5th pair of legs as that of the male of *A. typica* T. SCOTT (A. SCOTT, 1909, pl. 36, fig. 8). The 2nd maxilla of these species is furnished on the endopodite with a very large peculiar shaped sensory appendage, and short brush-shaped sensory setae; the apical lobes have long flexible, plumose setae, which are seen in the female of the genus *Amallophora*. According to A. SCOTT the sensory apparatus of the male of *Amallophora* is represented by one large stout appendage which looks like a sheaf of corn, and long by flexible, plumose setae on the apical portion of the 2nd maxilla, in which the present male specimens differ slightly from the description given by A. SCOTT. The small brush-shaped sensory setae arising from the endopodite of the 2nd maxilla are apt to be easily overlooked. So far as

the male is concerned, it is very difficult to separate these 5 males from either of the genus *Amallophora* or *Xanthocalanus* only by the structure of the 2nd maxilla, upon which A. SCOTT laid too much stress.

One of the most distinguished character of identifying the male is the structure of the 5th pair of legs. The mouth appendages of the male are generally reduced or deformed. The male 5th pair of legs of *Amallophora* is characterized by the peculiar structure of the distal joints of the exopodite of the left leg, namely, the 4th joint is furnished with a transverse row of long hairs on the inner distal angle; the 5th joint is furnished with a spine on the apex, and hairs on the inner margin of the joint (A. SCOTT, 1909, pl. 36, fig. 8). The present males appear to be properly included in the genus *Amallophora* by the reason that they have the similar structure in the 5th pair of legs as observed in the male of *Amallophora typica*. Nevertheless, all of the these male specimens have each beside, a large peculiarly shaped sensory appendage, also slender sensory setae on the endopodite of the 2nd maxilla. This latter character does not coincide with A. SCOTT's description of the male of *Amallophora*. In other respect, for instance, the structure of the rostrum and the flexible plumose seta arising from the apical lobes, they have the generic characters of the genus *Amallophora* given by A. SCOTT. Moreover, the present males have, except *A. irritans*, the same structure in the 1st maxilla as is found in the male of *Xanthocalanus greeni* FARRAN (cf. SARS, 1925, pl. 36, fig. 8; SEWELL, 1947, fig. 31, B.), viz. the 1st inner lobe has on the inner margin about 12 soft-skinned setae. The female of *Amallophora* has the usual slender setae on the 1st inner lobe of the 1st maxilla, but the male appears to have the deformed setae on the same appendage.

If males of *Xanthocalanus* were strictly confined to those which have in the 2nd maxilla strong curved spines coarsely dentate on the apical lobes, and slender sensory setae on the endopodite, these 5 males should be included in the genus *Amallophora*. The males of the genus *Xanthocalanus* has been described by SARS, SEWELL, and BRODSKY (1950); they are *X. greeni* FARRAN, *X. borealis* SARS, and *X. kurilensis* BRODSKY. These males have, on the other hand, the similar structure in the 2nd maxilla as in the female of the genus *Amallophora*. So far as the male is concerned, the generic characters of *Xanthocalanus* and *Amallophora* are, at present, very doubtful and inaccurate. It is ardently necessary to have more material both female and male of these two genera before we can settle the question about the generic characters of *Xanthocalanus* and *Amallophora*.

Amallophora serrata sp. nov.

(Fig. 90, a-l)

Male. Length, 5.19 mm: cephalothorax, 3.81 mm; abdomen, 1.38 mm. The cephalothorax oblong ovate. The frontal margin of the head rounded in dorsal

aspect, but slightly hollowed in lateral aspect (fig. b). The head separates from the 1st thoracic segment; the 4th and 5th thoracic segments are incompletely fused (fig. a). The lateral distal corner of the last thoracic segment rounded (fig. c). The rostral filaments slender and long, without any trace of articulation with the basal part (fig. d).

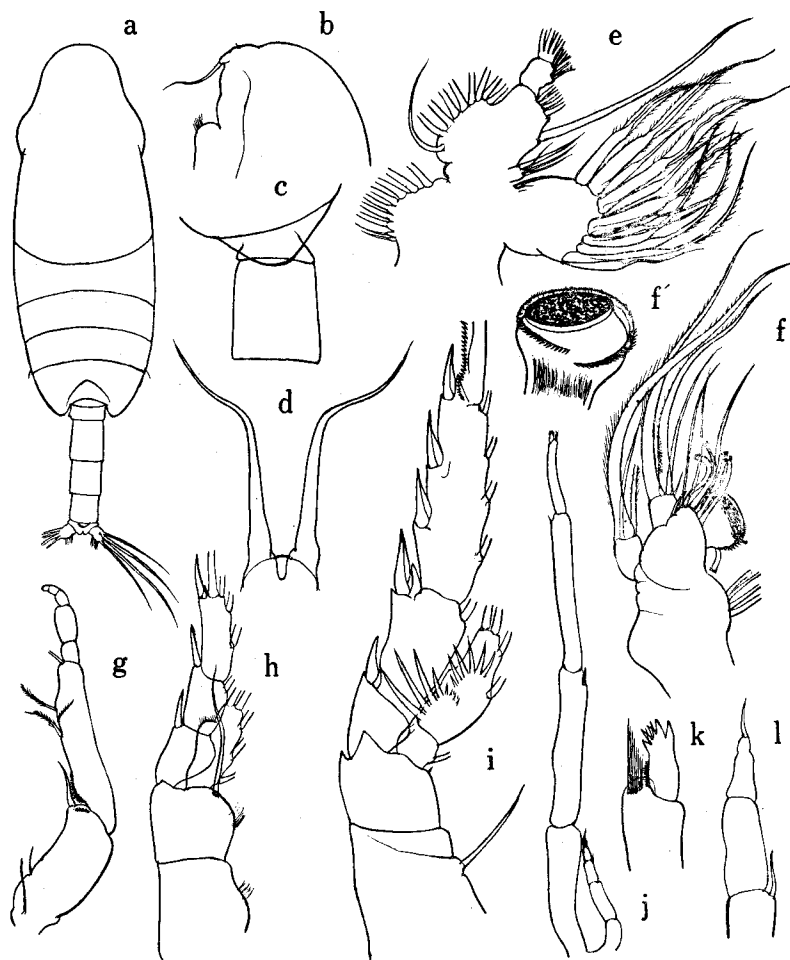


Fig. 90. *Amallophora serrata* sp. nov.

Male: a, dorsal aspect; b, head, lateral aspect; c, last thoracic segment, lateral aspect; d, rostrum, anterior aspect; e, 1st maxilla; f, 2nd maxilla; f', button-shaped sensory appendage; g, maxillipede; h, 1st leg; i, 2nd leg; j, 5th pair of legs; k, distal joint of left leg; l, distal joint right 5th leg.

The abdomen 5-segmented, the segments and furca in proportions 10:31:29:20:2:8=100. The genital opening is on the left distal margin of the 1st segment. The furcal rami about as long as wide.

The 1st antenna 20-jointed, extends about to the distal end of the 3rd abdominal segment; the joints are in the following proportions:

Joint	1	2	3	4	5	6	7	8-9	10-11-12-13	14
	52	56	32	27	27	27	26	46	120	40
	15	16	17	18	19	20	21	22	23	24-25
	63	67	72	70	63	78	24	46	42	24 = 1000;

the joints 8-9 are fused with the joints 10-12 on the posterior margin; the joint 12 is incompletely separated from the 13th anteriorly; the joints 24 and 25 are completely fused.

The 2nd antenna has the exopodite 1.2 times as long as the endopodite. The mandible has a very voluminous 2nd basal joint. The 1st maxilla as that of the male of *Xanthocalanus greeni* FARRAN; the setae on the 1st inner lobe are soft-skinned (fig. *e*). The 2nd maxilla has 3 usual slender setae, 6 small bud-like sensory setae, and one large button-shaped appendage with ciliated head, as shown in the figure, on the endopodite; the outer lobes have each long flexible plumose setae (figs. *f*, *f'*). The maxillipede has reduced number of setae on the basal joints; the 2nd basal joint is furnished with hairs on the anterior proximal margin (fig. *g*).

The 1st leg has 3-jointed exopodite and 1-jointed endopodite; the distal joint of the exopodite is long (fig. *h*). In the 2nd leg the 2nd joint of the endopodite is furnished with 2 groups of long spines on the posterior surface (fig. *i*). The 3rd and 4th legs are each furnished with groups of spines on the posterior surface of the 2nd and 3rd joints of the endopodite.

The 5th pair of legs 5-jointed (fig. *j*). The right leg very short, extending only to the distal margin of the 1st joint of the left leg; the terminal joint has an apical spine; the 3rd joint has a small spine on the outer distal margin (fig. *l*). The left leg very slender and long reaching the distal end of the furca; the terminal joint is small and serrated on the distal margin; the inner proximal margin of the joint is furnished with hairs (fig. *k*); the 4th joint has a tuft of hairs on the inner distal angle; the 3rd joint has a small spine on the outer distal margin; the 2nd joint has a rudimentary endopodite on the inner distal margin.

Remarks. The present male specimen differs from any of the hitherto known species in the structure of the 5th pair of legs. The left 5th leg is similar in structure to that of the right leg of *Scolecithricella ctenopus* GIESBREGHT. In the 2nd to 4th legs the terminal spine of the exopodite is distorted as figured by SEWELL (1929, p. 214, fig. *f'*) and is furnished with teeth of varying sizes but they are more finely arranged in the present male specimen. The systematic position of the present species appears to be somewhat doubtful. Nevertheless, the structure of the 2nd maxilla clearly indicates that the species belongs to the genus

Xanthocalanus. The male of *S. ctenopus* has a slender spine with small denticles on the distal outer margin of the 5th lobe of the 2nd maxilla and 3 long vermiform and 6 bud-like sensory filaments on the endopodite. In the genus *Scolecithricella* the lateral distal corner of the last thoracic segment is usually rounded; in this *S. ctenopus* is a single representative which has a pointed lateral distal corner on the last thoracic segment both in the female and male. The 5th pair of legs of *S. ctenopus* differ in the structure from those usually seen in the males of *Scolecithricella*, and the female 5th leg indicates a close affinity of *S. ctenopus* with the genus *Xanthocalanus* or with *Parundinella* which has been recently established in the family Tharybidae by FLEMINGER (1957). The generic character of *Parundinella* is intermediate between those of *Scolecithricella* and *Xanthocalanus*. At any rate *S. ctenopus* is a stranger in the genus *Scolecithricella*.

Occurrence. One male in Suruga Bay from the depth 1000-0 m, July, 1937.

Amallophora cornifer sp. nov.

(Fig. 91, a-k)

Male. Length, 3.00 mm: cephalothorax, 2.16 mm; abdomen, 0.84 mm. The cephalothorax elongate ovate. The head separates from the 1st thoracic segment; the last 2 segments are completely fused (fig. a). The frontal margin of the head slightly produced in dorsal aspect and narrowly rounded in lateral aspect (fig. b). The lateral distal corner of the last thoracic segment rounded (fig. c). The rostrum has a basal part producing forward, to which 2 strong filaments are attached; the filaments attenuate into fine points (fig. e).

The abdomen 5-segmented; the segments and furca in the proportions 13:27:25:19:6:10=100. The furcal rami a little wider than long.

The 1st antenna 21-jointed, extends to the distal end of the 2nd abdominal segment; the joints 8-9-10-11-12 are fused, but the joints 8 and 9 are incompletely fused; the total length of the 1st antenna measured 2.75 mm; the joints are in the following proportions:

Joint	1	2	3	4	5	6	7	8-9-10-11-12	13	14
	45	52	26	23	26	26	23	130	35	35
	15	16	17	18	19	20	21	22	23	25
	59	68	71	71	68	39	35	33	55	49

29=1000;

The 1st joint has a moderately large pointed process directing posteriorly on the distal angle of the joint (fig. d). The 2nd antenna has the exopodite 1.6 times as long as the endopodite. The mandible has the exopodite as long as the endopodite; the biting part reduced. The 1st maxilla has 9 setae on the outer lobe, 10 setae on the exopodite; the setae on the 1st inner lobe soft-skinned (fig. f). The 2nd maxilla with one large button-like sensory appendage, and 6 small

bud-like sensory setae on the endopodite; the outer lobes have each long flexible spines (fig. *g*). The maxillipede as usual; the 1st basal joint has a small sensory setae on the anterior proximal margin (fig. *h*).

The swimming legs mutilated except the 1st and 5th. The 5th pair of legs 5-jointed; the right leg short, slightly exceeding the distal margin of the 1st joint of the left leg; the 3rd joint has an outer edge spine; the 5th joint has a small apical and a subapical outer marginal spine. The left leg long, extending

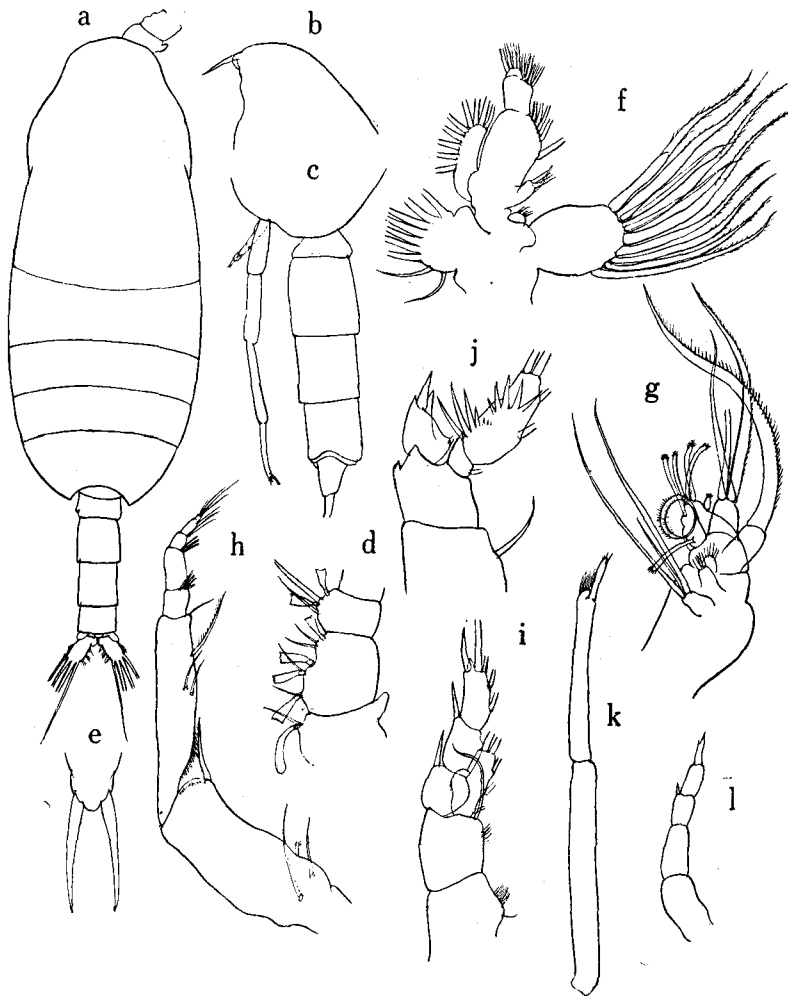


Fig. 91. *Amallophora cornifer* sp. nov.

Male: *a*, dorsal aspect; *b*, head, lateral aspect; *c*, last thoracic segment and abdomen, lateral aspect; *d*, proximal joints of 1st antenna; *e*, rostrum, anterior aspect; *f*, 1st maxilla; *g*, 2nd maxilla; *h*, maxillipede; *i*, 1st leg; *j*, 2nd leg; *k*, distal joints of left 5th leg; *l*, right 5th leg.

about to the distal end of the abdomen; the terminal joint has a small spine and hairs on the distal margin; the 4th joint has a transverse row of spines on the distal outer margin (fig. *k*). The 1st and 2nd legs as figured (figs. *i*, *j*).

Remarks. The specimen can be easily distinguished from other known males by the peculiar process on the 1st joint of the 1st antenna and the structure of the 5th pair of legs.

Occurrence. One male from Suruga Bay in the haul 600–400 m, November, 1937.

Amallophora crassirostris sp. nov.

(Fig. 92, *a-k*)

Male. Length, 3.53 mm: cephalothorax, 2.65 mm; abdomen, 0.88 mm. The cephalothorax oblong ovate. The head separates from the 1st thoracic segment; the 4th and 5th thoracic segments are separate (fig. *a*). The frontal margin of the head bluntly triangular in dorsal aspect, and slightly sinuate in lateral aspect (fig. *b*). The lateral distal corner of the last thoracic segment rounded (fig. *c*). The rostrum bifurcates; the rami very robust and short, direct outwardly at the apical portion (fig. *d*).

The abdominal segments and furca in the proportions 18:26:20:20:2:14 = 1000; the furcal rami parallel, 1.4 times as long as wide.

The 1st antenna 20-jointed, exceeds the distal end of the abdomen by terminal 2 joints; the joints are in the following proportions:

Joint	1	2	3	4	5	6	7	8-9	10-11	12-13	14
	13	52	26	26	26	26	28		206		46
	15	16	17	18	19	20	21	22	23	24	25
	54	54	54	54	54	44	44	41	59	53	31=1000;

the joints 9–10, and 12–13 are partially separate. The 2nd antenna has the exopodite about 1.4 times as long as the endopodite (10:7); the 2nd joint of the endopodite has 14 setae on the distal margin. The mandible has the endopodite a little longer than the exopodite (13:15). The 1st maxilla has long setae, somewhat soft-skinned in nature, on the 1st inner lobe; the 2nd inner lobe has 2 short setae; the 3rd inner lobe has 2 setae, of which the proximal one is short; the 2nd basal joint has 3 setae, of which the proximal one is strong; the endopodite has 2+1+3 setae; the exopodite has 9 setae; the outer lobe has 6 setae, of which the distal one is located apart from the rest (fig. *e*). The 2nd maxilla has 5 small sensory setae and one large sensory appendage on the endopodite; the apical lobes have each long flexible setae (fig. *f*). The maxillipede has the basal joints of about equal lengths; the endopodite short, about half the length of the basal joint.

The 1st leg has no interesting features (fig. *g*). The 2nd leg has 3-jointed exopodite and 2-jointed endopodite; the 2nd joint of the endopodite is furnished with 2 groups of spines on posterior surface; the terminal spine of the exopodite much longer than the 3rd joint of the exopodite, and has 56 serration (fig. *h*). The 3rd and 4th legs as usual; the 2nd and 3rd joints of the endopodite of the 3rd leg (fig. *i*) and the 2nd joint of the endopodite of 4th leg (fig. *j*) are furnished with groups of spines on the posterior surface.

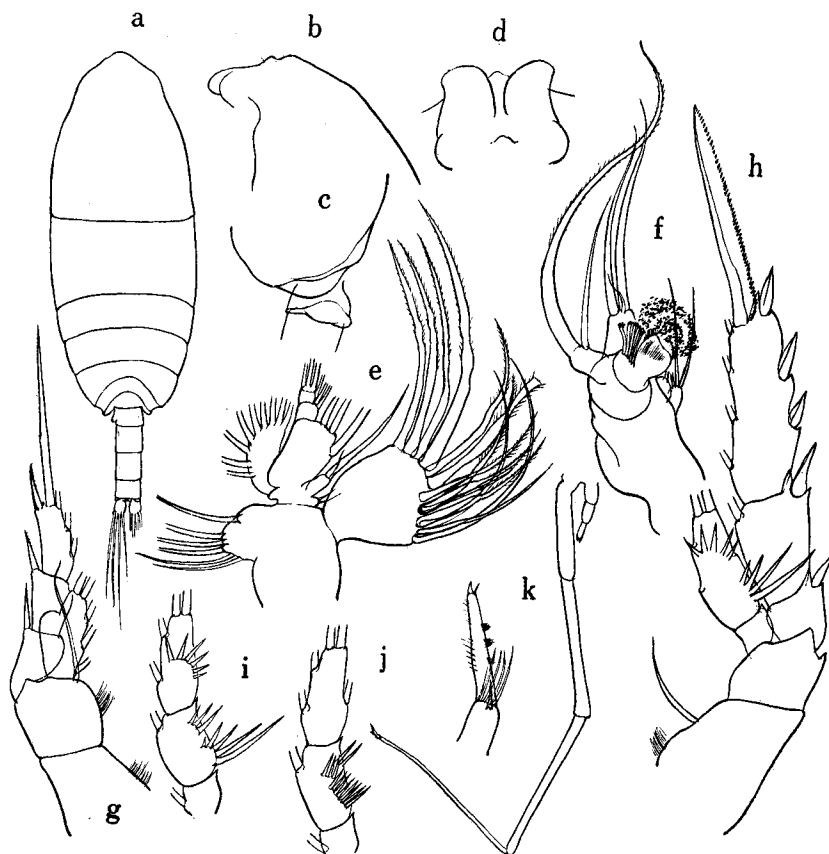


Fig. 92. *Amalophora crassirostris* sp. nov.

Male: *a*, dorsal aspect; *b*, head, lateral aspect; *c*, last thoracic segment, lateral aspect; *d*, rostrum, anterior aspect; *e*, 1st maxilla; *f*, 2nd maxilla; *g*, 1st leg; *h*, 2nd leg; *i*, endopodite of 3rd leg; *j*, endopodite of 4th leg; *k*, 5th pair of legs.

The left 5th leg 5-jointed and long, about 2 times as long as the 4th leg including the terminal spine of the exopodite. The distal joint is very small; it is furnished with 2 apical spines, of which the inner one is small, and has tufts of hairs on the lateral margins. The 4th joint is very slender, and has on the distal margin an inner marginal spine and 5 slender spines. The right leg

3-jointed and short, extending about to the middle of the 1st joint of the left leg; the distal joint has small spines (fig. *k*).

Remarks. The present specimen differs from the foregoing males in the structure of the rostrum and in the 5th pair of legs.

Occurrence. One male in Sagami Bay, from the depth 1000-0 m, November, 1937.

Amallophora oculata sp. nov.

(Fig. 93, *a-l*)

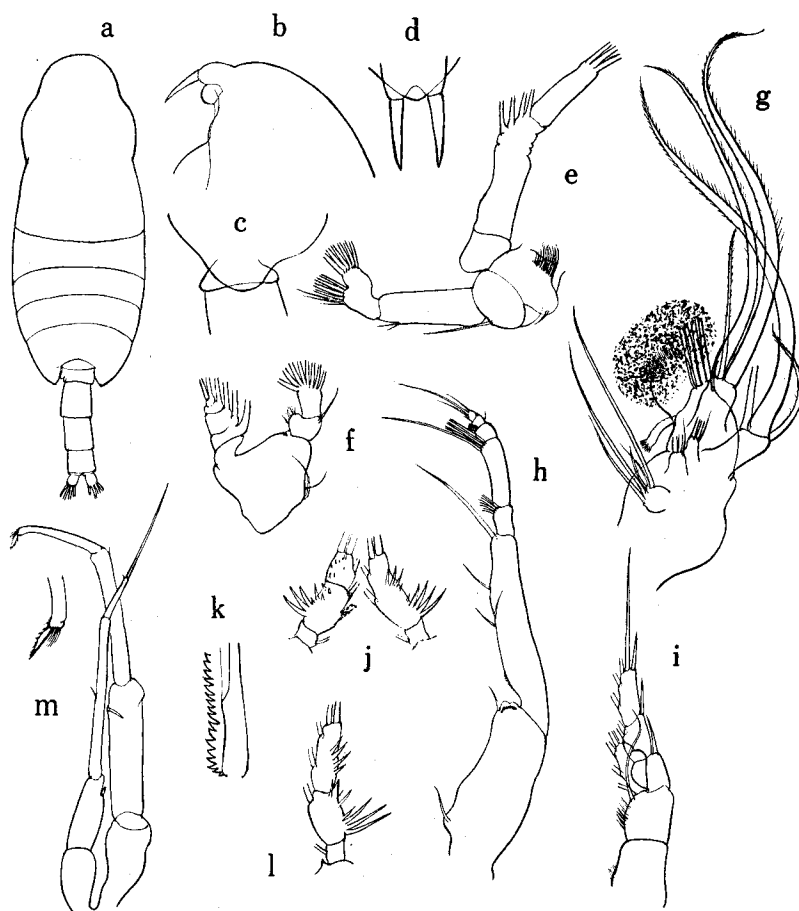


Fig. 93. *Amallophora oculata* sp. nov.

Male: *a*, dorsal aspect; *b*, head, lateral aspect; *c*, last thoracic segment, lateral aspect; *d*, rostrum, anterior aspect; *e*, 2nd antenna; *f*, mandible; *g*, 2nd maxilla; *h*, maxillipede; *i*, 1st leg; *j*, endopodite of 2nd leg; *k*, terminal spine of exopodite of 2nd leg; *l*, endopodite of 3rd leg; *m*, 5th pair of legs.

Male. Length, 3.40 mm: cephalothorax, 2.50 mm; abdomen, 0.90 mm. The cephalothorax oblong ovate. The head separates from the 1st thoracic segment; the last 2 thoracic segments are fused (fig. *a*). The frontal margin of the head hollowed near the base of the rostrum when viewed from the lateral (fig. *b*). The lateral distal corner of the last thoracic segment narrowly rounded (fig. *c*). The rostrum consists of 2 strong spines attached to the basal portion (fig. *d*). There is a single ventral eye which is of deep carmine-red under the projection of the forehead (fig. *b*).

The abdominal segments and furca in the proportions 12:30:26:16:6:10 = 100. The furcal rami slightly oblique, about as long as wide.

The 1st antenna 19-jointed, reaches the distal end of the abdomen; the joints 8-14 are fused; the joints are in the following proportions:

Joint	1	2	3	4	5	6	7	8-9-10-11-12-13-14
	21	60	30	27	27	27	27	211
	15	16	17	18	19	20	21	22 23 24 25
	60	66	69	69	63	45	39	33 51 48 27=1000.

The 2nd antenna has the exopodite 1.5 times as long as the endopodite; the 1st basal joint has a tuft hairs on the posterior surface (fig. *e*). The mandible has a robust 2nd basal joint (fig. *f*). The 1st maxilla as that of *Amallophora serrata*, and has fleshy setae on the 1st inner lobe. The 2nd maxilla has a large button-shaped sensory appendage and 5 small brush-shaped sensory setae on the endopodite; the setae on the apical lobes long and flexible (fig. *g*). The maxilliped is slender; the basal joints are furnished with poor setae on the anterior margin; the 2nd joint of the endopodite slender and long (fig. *h*).

The 1st leg as those of the other members of the genus (fig. *i*). The 2nd to 4th legs as usual; the endopodite of the 2nd leg 2-jointed, those of the 3rd (fig. *l*) and 4th legs 3-jointed. The posterior surface of the joints of the endopodite of the 2nd leg had an abnormal structure; the right leg has 3-jointed endopodite as shown in the figure (fig. *j*).

The 5th pair of legs 5-jointed. The terminal joint of the right leg very slender; the 3rd and 4th joints have each an outer marginal spine; the 2nd joint has a small rudimentary endopodite. The terminal joint of the left leg small; the inner margin of the joint serrated; the 4th joint has slender spines on the distal margin; the 3rd joint has a small outer-edge spine; the 2nd joint has a rudimentary endopodite (fig. *m*).

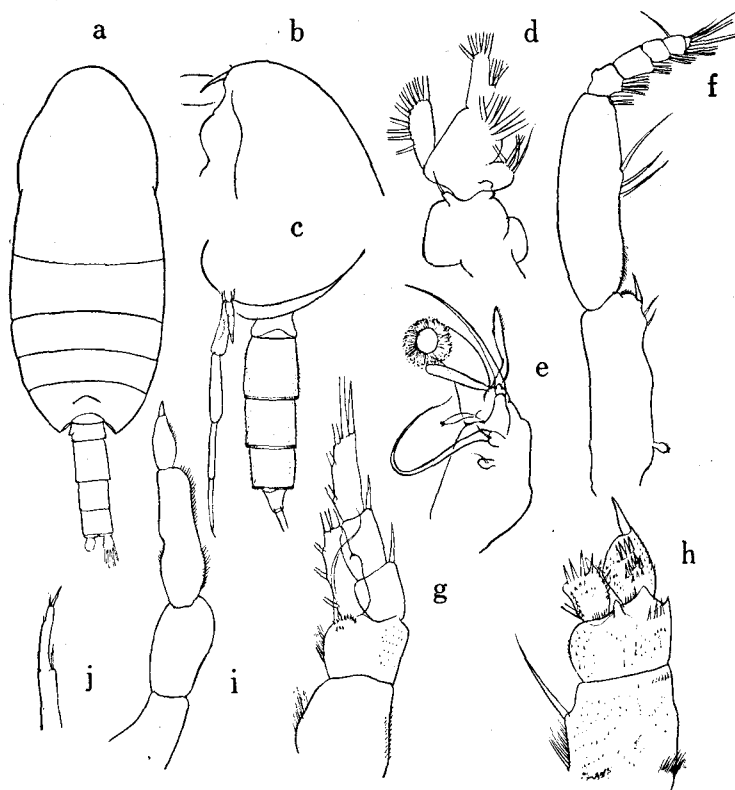
Remarks. The specimen is easily recognized by the possession of a lens at the base of the rostrum and by the structure of the 5th pair of legs.

Occurrence. One male in Sagami Bay from the depth 1000-0 m, November, 1937.

Amalophora irritans sp. nov.

(Fig. 94, a-j)

Male. Length, 2.43 mm: cephalothorax, 1.79 mm; abdomen, 0.64 mm. The cephalothorax oblong ovate in dorsal view. The head separates from the 1st thoracic segment. The 4th and 5th thoracic segments incompletely separate (fig.

Fig. 94. *Amalophora irritans* sp. nov.

Male: *a*, dorsal aspect; *b*, head, lateral aspect; *c*, last thoracic segment and abdomen, lateral aspect; *d*, 1st maxilla; *e*, 2nd maxilla; *f*, maxillipede; *g*, 1st leg; *h*, 2nd leg; *i*, right 5th leg; *j*, distal joint of left 5th leg.

a). The lateral distal corner of the last thoracic segment rounded (fig. *c*). The rostrum bifurcate, attenuates into 2 slender filaments (fig. *b*).

The abdominal segments and furca in the proportions 14:30:23:20:3:10=100. The furcal rami a little longer than wide. The 2nd to 4th segments are furnished with fine spinules.

The 1st antenna 23-jointed, extends about to the distal end of the thoracic

segment; the distal 3 joints are broken off; the remaining joints are in the following proportions:

Joint	1	2	3	4	5	6	7	8-9-10	11	12	13	14
	14	13	7	6	7	6	7	24	6	7	8	8
	15	16	17	18	19	20	21	22	23	24	25	
	9	10	10	11	11	9	9	10	—	—	—	

The 2nd antenna has the exopodite about 1.2 times as long as the endopodite (36:29); the posterior surface of the 1st basal joint is furnished with rows of long curled hairs. The 1st maxilla has 10 setae on the exopodite, 5+3 setae on the endopodite, 5 setae on the 2nd basal, 4 setae on the 3rd inner lobe; the 1st and 2nd inner lobes are much reduced (fig. *d*). The 2nd maxilla has a single large sensory appendage on the endopodite; no other setae are observed on the endopodite; the setae on the lobes are much reduced (fig. *e*). The maxilliped has a small sensory appendage on the anterior proximal margin of the 1st basal joint; the 2nd basal joint is thick (fig. *f*).

The 1st pair of legs as usual; the distal joint of the exopodite slender and long; the 1st basal joint is furnished with minute spinules on the outer margin; the 2nd basal joint has 2 rows of spinules on the inner distal margin at the base of the endopodite; the basal joints and the joints of the exopodite are covered with very minute spinules on the posterior surface (fig. *g*). In the 2nd to 4th pair of legs the 2nd and 3rd joints of the exopodite and endopodite are broken off. In the 2nd leg the 1st basal joint has a row of hairs on the anterior proximal margin; the 2nd basal has denticles on the inner margin, and several remarkable spines on the posterior surface at the base of both exopodite and endopodite; the 1st joint of the exopodite has several transverse rows of spines, and the 1st joint of the endopodite carries a corona of spines on the posterior surface; the basal joints and joints of the exopodite and endopodite are, beside the remarkable spines, covered with spinules both on the anterior and posterior surfaces (fig. *h*).

The 5th pair of legs 5-jointed. The right leg short, not reaching the distal margin of the 1st joint of the left leg; the distal joint has an apical spine and short hairs on the outer margin; the 3rd and 4th joints are fused; each joint carries short hairs on the outer margin (fig. *i*). The left leg long, exceeding the distal margin of the abdomen; the distal joint has 2 apical spines, of which the outer one is very minute, and a small spine on the distal 1/3 of the outer margin; the 4th joint has a slender spine on the inner distal angle (figs. *c*, *j*).

Remarks. The present specimen differs from the foregoing species in its small size, the structure of 1st to 4th swimming legs, and also in the 5th pair of leg.

Occurrence. One male in Sagami Bay from the depth 1000-0 m, November, 1937.

Genus *Heteramalla* G. O. SARS

The genus comprises a single species, *Heteramalla dubia* (T. SCOTT). The species has been recorded by A. SCOTT from the Malay Archipelago, but no example of the genus has been detected in my collection. The genus is characterized by the possession of 2 well developed sensory appendages on the endopodite of 2nd maxilla and 2-jointed exopodite in the 1st pair of legs.

Genus *Onchocalanus* G. O. SARS

Onchocalanus is closely related to the genus *Xanthocalanus* GIESBRECHT, from which the former differs in the shape of the rostrum, the structure of the 2nd maxilla, the spinulation of the swimming legs, and also in the shape of the 5th pair of legs. Only a single species, *O. trigonocephs* SARS has been recorded by SEWELL from the Indian Seas. A. SCOTT recorded the occurrence of *O. cristatus* SARS and *O. hirtipes* SARS from the Malayan region; the latter species is identical with *O. affinis* WITH. In the present collection 3 species have been found from the deep water: *O. trigonocephs* SARS, *O. cristatus* (WOLFENDEN), and *O. affinis* WITH.

In the 2nd maxilla of the present genus two of the sensory appendages are stouter than the others. This character indicates that the genus *Onchocalanus* is closely related to *Heteramalla* SARS. The maxillipede has a sensory appendage on the anterior margin of the 1st basal joint; the proximal anterior margin of the 2nd basal joint is rather coarsely denticulated. The 5th pair of legs 3-jointed in the female, 5-jointed in the male. The male has reduced sensory appendages on the endopodite of 2nd maxilla.

Onchocalanus trigonocephs SARS

(Fig. 95, a-h)

Onchocalanus trigonocephs SARS, 1925, p. 144, pl. 40; SEWELL, 1929, p. 176; JESPERSEN, 1934, p. 83; SEWELL, 1947, p. 139, text-fig. 34; WILSON, 1950, p. 274; VERVOORT, 1950, p. 12, figs. 3, 4.

The present specimens are in the copepodid stages. The specimen in the copepodid stage IV measured 4.56 mm in total length. The cephalothorax elongate ovate. The last thoracic segment produced triangularly, pointed at the apex (fig. h). The rostrum straight and bifurcate (fig. i). The abdomen 3-segmented.

The 1st antenna exceeds the end of the furca by distal two joints. The mouth parts well developed.

The 1st to 4th swimming legs have each 2-jointed exopodite. The 1st joint of the exopodite of the 1st leg has 4 spines at the base of the outer-edge spine.

The 5th pair of legs 3-jointed. The terminal joint has 2 apical spines, of which the outer marginal one is very small. The 2nd joint has a minute outer edge spine (fig. *j*).

The immature female specimen in the copepodid stage V measured 5.94 mm. General appearance as the specimen in the IV copepodid stage (figs. *a, b, c*).

The abdomen 4-segmented, contained 4 times in the length of the cephalothorax. The furcal rami about as long as wide. There is a small spine at the base of the 4th inner furcal seta.

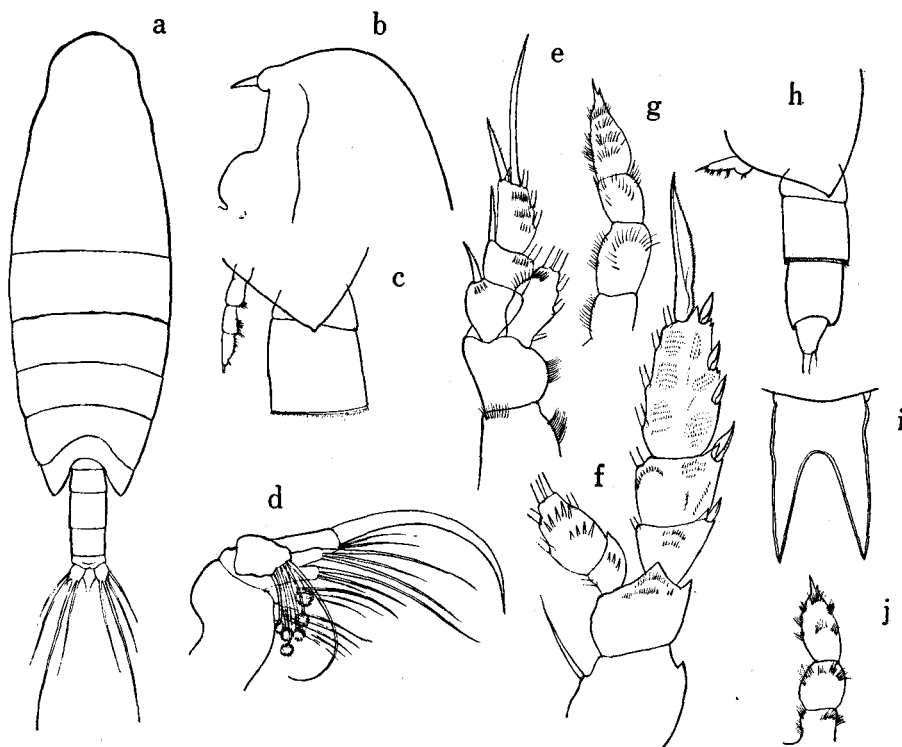


Fig. 95. *Onchocalanus trigonocephus* Sars.

Immature female: *a*, dorsal aspect; *b*, head, lateral aspect; *c*, last thoracic segment, lateral aspect; *d*, 2nd maxilla; *e*, 1st leg; *f*, 2nd leg; *g*, 5th leg. Immature female in the copepodid stage IV: *h*, last thoracic segment and abdomen, lateral aspect; *i*, rostrum, anterior aspect; *j*, 5th leg.

The 1st antenna extends to the end of the furca. The 2nd antenna has the exopodite about as long as the endopodite. The mandible has the exopodite slightly shorter than the endopodite. The 1st maxilla as shown in Sars' figure (pl. XL, fig. 7). The spinulation of the various parts as follows: the outer lobe, 9 setae; the exopodite, 10 setae; the endopodite, 4, 3, 3 setae; the 2nd basal, 5 setae; the 3rd inner lobe, 4 setae; the 2nd inner lobe, 2 setae. In the 2nd maxilla

the 5th lobe has a powerful spine. The distal joints of the endopodite have both bud-like and slender filaments (fig. *d*). The maxillipede slender, the 2nd joint of the endopodite 2 times as long as the 1st.

The 1st leg has 3-jointed exopodite and 1-jointed endopodite. The 1st basal joint has a row of stiff hairs on the distal margin of the anterior surface. The 1st joint of the exopodite has 4 spinules at the base of the outer-edge spine. The 2nd joint has 6 spinules at the base of the inner marginal seta. The 3rd joint has 4, 7, and 7 spinules on the posterior surface (fig. *e*). The 2nd leg has 3-jointed exopodite and 2-jointed endopodite. The posterior surface of the 2nd and 3rd joints of the exopodite are furnished with spinules. The 1st and 2nd joints of the endopodite have each rows of spinules. The terminal spine of the exopodite finely serrated. The teeth at the proximal make fenestella (fig. *f*). The 3rd and 4th legs slightly undeveloped.

The 5th pair of legs 4-jointed, symmetrical. The 3rd joint has a spine on the outer distal margin. The 4th joint has beside bifurcated apical spine, 2 very small ones on the inner margin. All the joints are furnished luxuriously with stiff hairs (fig. *g*).

Remarks. The adult female specimen recorded by SEWELL from the central area of the Arabian Sea measured 7.33 mm. SARS' example from the North Atlantic measured 7.5 mm, WITH's measured 8.3 mm.

Occurrence. Two immature females from Sagami and Suruga Bays in the hauls 1000-0 m, July, 1937.

Distribution. The species has been recorded from the North Atlantic, Mediterranean Sea, Arabian Sea and Antarctic.

Onchocalanus cristatus (WOLFENDEN)

(Fig. 96, *a-g*)

Onchocalanus cristatus FARRAN, 1908, p. 49; A. SCOTT, 1909, p. 82; WOLFENDEN, 1911, p. 277; WITH, 1915, p. 228, pl. 7, fig. 6, pl. 8, fig. 17; SARS, 1925, p. 147, pl. 41, figs. 1-5; JESPERSEN, 1934, p. 84; VERVOORT, 1950, p. 9, figs. 1 and 2; WILSON, 1950, p. 273.

Male. Length 6.20: the cephalothorax, 4.70 mm; the abdomen, 1.50 mm. The cephalothorax elongate ovate. In dorsal view the anterior margin of the head produced, forming a low crest. The lateral distal corner of the last thoracic segment triangularly produced and terminates into a sharp point (fig. *a*). The rostral spines strong (fig. *b*).

The abdomen 5-segmented, contained 3.1 times in the length of the cephalothorax. The segments and furcal rami are in the proportional length 19:31:25:14:5:5=100. The furcal rami 1.6 times as wide as long. The 2nd to 5th segments are covered with short hairs. The 2nd and 3rd segments are furnished with small teeth on the distal margin (fig. *c*).

The 1st antenna extends to the distal end of the 3rd abdominal segment. The mouth parts as those of the male of *O. trigonoceps* figured by Sars. The 2nd maxilla slightly reduced and soft-skinned (fig. *d*).

The 1st leg has 3-jointed exopodite. The 2nd and 3rd joints have each rows of spinules on the posterior surface. The endopodite 1-jointed, bears also a row of spinules on the posterior surface. The 2nd leg has 3-jointed exopodite and 2-jointed endopodite. The posterior surface of the exopodite and endopodite are furnished with groups of spinules. The terminal spine of the exopodite has

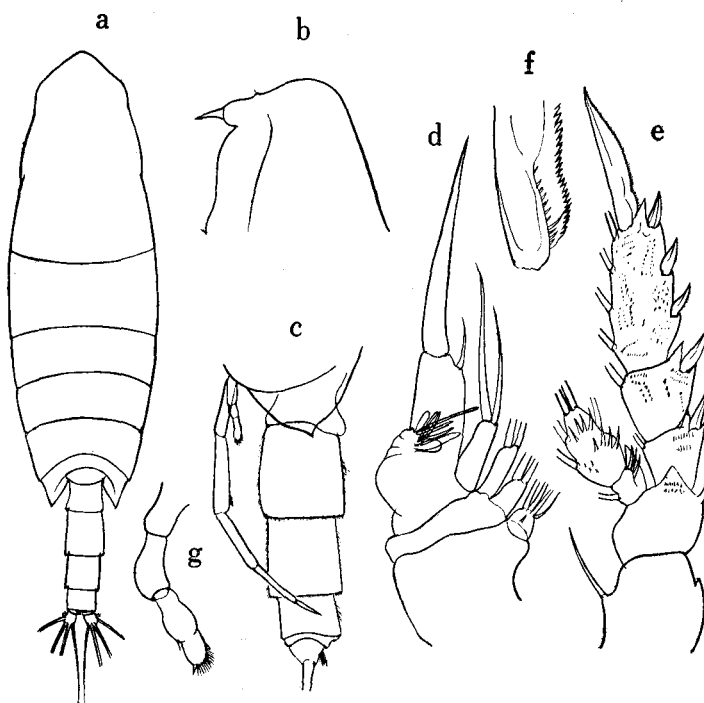


Fig. 96. *Onchocalanus cristaus* (WOLFENDEN).

Male: *a*, dorsal aspect; *b*, head, lateral aspect; *c*, last thoracic segment and abdomen, lateral aspect; *d*, 2nd maxilla; *e*, 2nd leg; *f*, terminal spine of exopodite of 2nd leg; *g*, right 5th leg.

about 60 serrations (fig. *e, f*). The 3rd and 4th legs have each 3-jointed exopodite and endopodite. The posterior surface of the joints are furnished with fine spinules.

The left 5th leg 5-jointed and long. The distal joint terminates into a fine spine (fig. *c*). The right leg 3-jointed. The distal joint broad, composed of 3 joints incompletely fused, and is furnished on the distal margin with an outer marginal spine and short hairs (fig. *g*).

Remarks. The specimen resembles the male of *O. trigonocephs* Sars but the median crest of the forehead and the terminal joint of the right 5th leg are the characters which distinguish the present specimen from the former.

Occurrence. One male from Sagami Bay in the hauls from 1000 m to the surface, October, 1937.

Distribution. North Atlantic, Mediterranean Sea and Malay Archipelago.

Onchocalanus affinis WITH

(Fig. 97, a-h)

Onchocalanus affinis, WITH, 1915, p. 233, text-fig. 76, a-e, and 76, a-d; Sars, 1925, p. 150, pl. 41, figs. 12-18; SEWELL, 1947, p. 135, text-fig. 32, a-g, and 33, a-e; VERVOORT, 1950, p. 26, text-fig. 14, a, b, c.

Male. Length, 5.86 mm: cephalothorax, 4.63 mm; abdomen, 1.23 mm. The abdomen is contained 3.8 times in the length of the cephalothorax. The cephalothorax oblong ovate. The head separates from the 1st thoracic segment. The 4th and 5th thoracic segments are separate. The lateral distal corner of the last thoracic segment rounded (figs. a, c). The rostrum has a strong base to which two short spines are attached (figs. b, d).

The abdominal segments and furcal rami are in the proportional lengths 22:29:20:13:4:12=100. The 2nd to 4th segments are fringed with fine teeth on the distal border. The furcal rami about as long as wide.

The 1st antenna 24-jointed, extends to the distal end of the 4th abdominal segment. The joints 19 and 20 are fused on the right side. The 1st antenna 24-jointed, extends to the distal end of the 4th abdominal segment. The joints 19 and 20 are fused on the right side. The joints are in the following proportional lengths:

Joint	1	2	3	4	5	6	7	8-9	10	11	12	13	14
	17	37	25	24	31	29	24	40	32	29	34	47	48
	15	16	17	18	19	20	21	22	23	24	25		
	63	65	67	63	60	51	45	47	54	57	21=1000.		

The joints 20, 21 and 24 are devoid of aesthetascs.

The 2nd antenna has the exopodite $3/4$ as long as the endopodite. The mandible has no interesting features. The 1st maxilla has very poor setae on the 1st inner lobe (fig. e). The 2nd maxilla has a strong spine on the 5th lobe. The distal joints poorly developed (fig. f). In the maxillipede the 2nd basal joint has a row of serrations at the anterior proximal margin. The spinulation of the 1st basal joint much reduced; there is a minute sensory filament at the proximal margin (fig. g).

The 1st leg has 3-jointed exopodite and 1-jointed endopodite. The outer

edge spine of the joints slender and long. The posterior surface of the joints of exopodite and endopodite are furnished with groups of spinules (fig. *h*). The 2nd to 4th legs are broken off in the specimen.

The left 5th leg 5-jointed and long. The distal joint has 2 apical spines. The inner margin haired. The 3rd and 4th joints have each a distal spine. The 2nd joint has 3 curved spines near the distal border. The right leg 4-jointed and short, extending a little beyond the distal margin of the 1st joint of the left leg. The distal joint has an apical and a small outer-edge spine (fig. *i*).

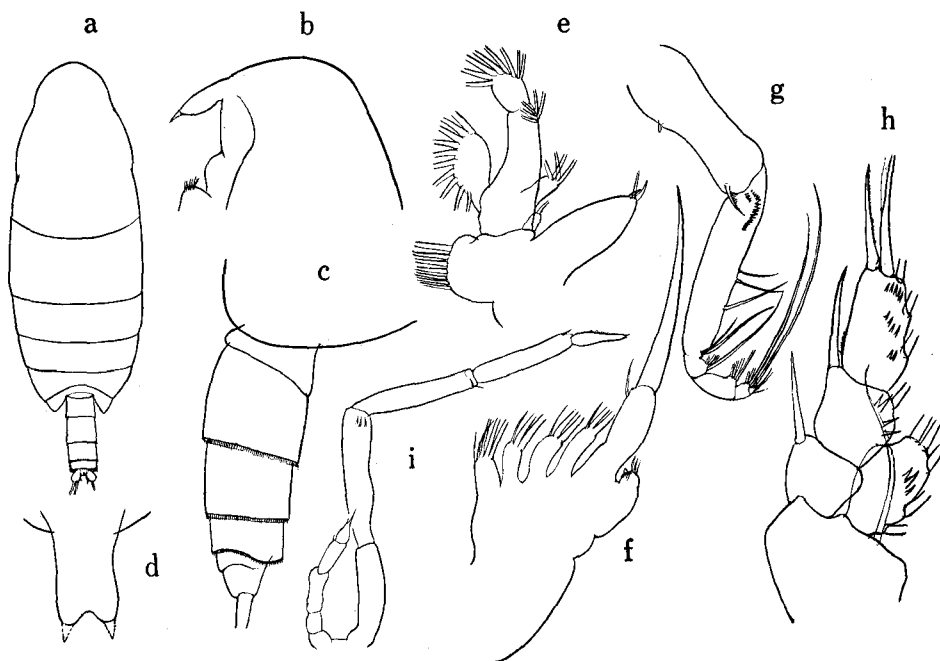


Fig. 97. *Onchocalanus affinis* WITH.

Male: *a*, dorsal aspect; *b*, head, lateral aspect; *c*, last thoracic segment and abdomen, lateral aspect; *d*, rostrum, anterior aspect; *e*, 1st maxilla; *f*, 2nd maxilla; *g*, maxillipede; *h*, 1st leg; *i*, 5th pair of legs.

Remarks. The present male specimen agrees with *O. affinis* WITH in having 3 curved spines on the 2nd joint of the left 5th leg as described and figured by VERVOORT. The female specimen described and figured by A. SCOTT under the name *O. hirtipes* is, according to both SEWELL and VERVOORT, identical with *O. affinis* WITH.

Occurrence. One male in Suruga Bay from the depth 1000–0 m, July 1937.

Distribution. North Atlantic, Arabian Sea, Ombai Strait, and Flores Sea.

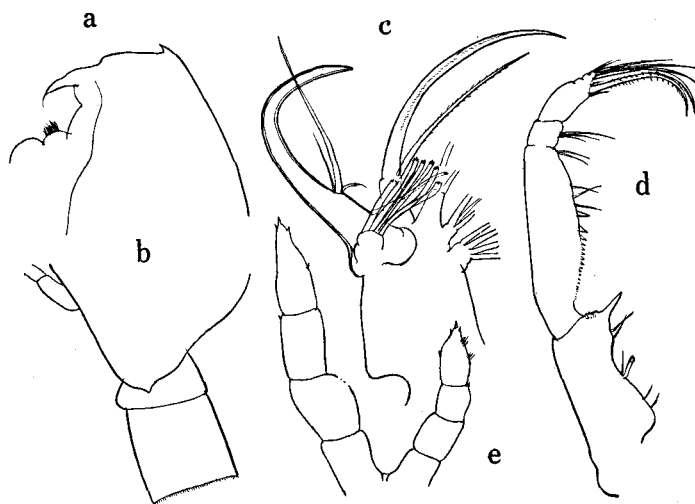
Genus *Cornucalanus* WOLFENDEN

There have 3 species been recorded from the Malayan region and Indian Seas: *Cornucalanus chelifer* (THOMPSON), *C. simplex* WOLFENDEN, and *C. indicus* SEWELL; among which two species, *C. chelifer* and *C. indicus* occurred in my collection. The genus is distinguished from any of the members of the family Phaennidae by the possession of powerful, curved claw on the 5th lobe of the 2nd maxilla, and strong spines which is coarsely dentate on the 2nd and 3rd joints of the endopodite of the maxillipede.

Cornucalanus chelifer (THOMPSON)

(Fig. 98, a-e)

Cornucalanus chelifer, FARRAN, 1908, 1908, p. 49; WITH, 1915, p. 222; SARS, 1925, p. 151; SEWELL, 1929, p. 177; WILSON, 1932, p. 74; JESPERSEN, 1934, p. 84; WILSON, 1950, p. 192; VERVOORT, 1957, p. 91.

Fig. 98. *Cornucalanus chelifer* (THOMPSON).

Immature male: a, head, lateral aspect; b, last thoracic segment, lateral aspect; c, 2nd maxilla; d, maxillipede; e, 5th pair of legs.

Immature male. Length, 5.33 mm. The abdomen is contained about 2.9 times in the length of the cephalothorax. General appearance as in the adult female. The head has a median spine (fig. a). The lateral distal corner of the last thoracic segment produced into a small projection (fig. b).

The abdomen 4-segmented; the segments and furca in the proportions 21:33:24:13:9=100. The furcal rami wider than long (6:8).

The 1st antenna 23-jointed, reaches back to the distal end of the last thoracic

segment; the joints 8-9 are fused. In the 2nd maxilla the endopodite has 7 sensory appendages (fig. *c*). In the maxillipede the 2nd basal has a row of spines on the anterior proximal margin, increasing in size distally, and there is a large isolated spine, separated by a short interval from the other (fig. *d*).

The 1st to 4th swimming legs as those of the adult female. The 5th pair of legs 4-jointed on either side; the left leg about 2 times as long as the right (fig. *e*).

Remarks. SEWELL's immature male specimen taken from the Indian Seas measured 5.4 mm. His specimen has no cephalic spine (Text-fig. 64, *a*); the 5th pair of legs is of about equal lengths. As a general rule, the immature male has a general resemblance to the adult female. The immature male of *O. chelifera* should have a median spine on the forehead. SEWELL describes that the general form of the body closely resembles the figure of *Cornucalanus magnus* WOLFENDEN. The 5th pair of legs figured by SEWELL is almost of equal lengths. The present immature male is in the 5th copepodite stage, and has the 5th pair of legs which agrees with the figure given by WITH (pl. VIII, figs. 15, 9). The adult male of the genus *Cornucalanus* has the left 5th leg much longer than the right; in this the immature male described and figured by SEWELL is not identical with *O. chelifera* (THOMPSON).

Occurrence. One immature male in Suruga Bay from the depth 1000-0 m, July, 1937.

Distribution. The species has a wide distribution in the deep waters of the Atlantic and Indo-West Pacific.

Cornucalanus indicus SEWELL

(Fig. 99, *a-g*)

Cornucalanus indicus, SEWELL, 1929, p. 179, text-fig. 66, *a-g*; BRODSKY, 1950, p. 236, fig. 148; VERVOORT, 1957, p. 93.

Immature female. Length, 6.86 mm: cephalothorax, 5.30 mm; abdomen, 1.56 mm. The head separates from the 1st thoracic segment. The frontal margin of the head rounded, without any trace of a median crest (fig. *a*). The last 2 thoracic segments are separate. The lateral distal corner of the 5th thoracic segment produced into a pointed tooth (fig. *b*).

The abdomen 4-jointed; the segments and furca in the proportions 23:30:21:15:11=100. The furcal rami as long as wide, and each furnished with a small spine and a seta near the base of the 3rd inner seta on the dorsal surface. The 2nd to 4th segments are striated finely on the marginal cuticle (fig. *c*).

The 1st antenna 24-jointed, reaches back to the posterior margin of the last thoracic segment; the joints 8-9 are fused, but 24 and 25 are separate. The 1st joint produced proximally on the anterior proximal corner (fig. *d*).

The mouth appendages agree fairly well with SEWELL's description and figures. The 2nd maxilla has 7 sensory appendages on the endopodite, of which the distal one is much longer than the others. In the maxillipede the 2nd basal is furnished proximally with a row of fine spinules, the middle part with spines which increases in size distally, and a large isolated spine apart from the others. There is a longitudinal row of denticles, 6 in number, along the anterior margin on the posterior surface. The 1st joint of the endopodite of the maxillipede bears 4 unequal setae; the 2nd joint has a short seta and a long spine

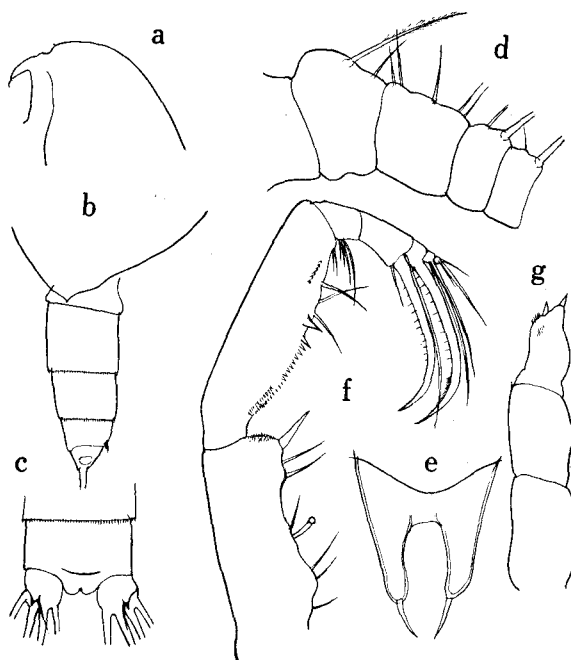


Fig. 99. *Cornucalanus indicus* SEWELL.

Immature female: *a*, head, lateral aspect; *b*, last thoracic segment and abdomen, lateral aspect; *c*, anal segment and furca, dorsal aspect; *d*, proximal joints of 1st antenna; *e*, rostrum, anterior aspect; *f*, maxillipede; *g*, 5th leg.

coarsely beset with teeth, 11 in number, along the proximal 2/3 of its length; the distal portion of the spine finely denticulated. The 3rd joint of the endopodite has the similar strong spine which has 14 isolated teeth and spinules on the distal portion (fig. *f*).

The 5th pair of legs consist of 3 joints of about equal lengths on either side; the distal joint shows slight indication of demarcation at the proximal 1/4 of the joint (fig. *g*).

Remarks. The present immature specimen is closely related to *C. chelifera*

and also to *C. indicus* SEWELL. *C. chelifer* is characterized by the possession of the cephalic spine. The specimen differs from *C. robustus* VERVOORT in the structure of the 5th pair of legs. The specimen is not clearly identical with *C. simplex* WOLFENDEN in its larger size and by the possession of an isolated tooth on the 2nd basal joint of the maxillipede. BRODSKY (1950) recorded the occurrence of *C. indicus* from the deep waters of the Far-eastern and Polar Seas. According to SEWELL's figure the last thoracic segment produced triangularly but the apex is bluntly pointed. BRODSKY's specimen has the last thoracic segment with short sharp point at the apex; the 5th pair of legs figured by BRODSKY agree quite well with my figure of the 5th feet of the immature female in the copepodite stage V; the distal joint is furnished with an apical and subapical spines; the surface of the joint is poorly furnished with spinules. BRODSKY's specimen measured 8.8-9.24 mm.

Occurrence. Two immature females in Sagami Bay from the depth 1000-0 m.

Distribution. Bay of Bengal, Far-eastern and Polar Seas of the U.S.S.R.

Genus *Cephalophanes* G. O. SARS

The genus has been represented by two species, *C. refulgens* SARS and *C. frigidus* WOLFENDEN. The latter has been recorded in the "Valdivia" collection from the Antarctic and Indian Oceans by WOLFENDEN. In my collection there occurred *C. frigidus* from the deep water of Sagami Bay. The geographical distribution of the species has now extended as far northward as the North Pacific.

The genus is closely related to *Xanthocalanus* GIESBRECHT, but it is characterized by the possession of a pair of very large eye or luminous organ on the head.

Cephalophanes frigidus WOLFENDEN

(Fig. 100, a-e)

Cephalophanes frigidus, WOLFENDEN, 1911, p. 284; STEUER, 1926, p. 183, text-fig. 8-14, 15-17; FARRAN, 1929, p. 254, fig. 20; VERVOORT, 1957, p. 93.

Female. Length, 4.75 mm: cephalothorax, 3.87 mm; abdomen, 0.88 mm. The cephalothorax oblong ovate. The head separates from the 1st thoracic segment; the last two segments are separate. The head has a pair of iridescent eyes. The rostral filaments slender. The lateral distal corner of the last thoracic segment rounded with a blunt process on the postero-distal margin (fig. d).

The abdominal segments and furca in the proportional lengths 38:23:19:10:10=100. The genital segment not produced below. The furcal rami slightly wider than long.

The 1st antenna 24-jointed, exceeds the distal margin of the furca by terminal

2 joints; the length of the 1st antenna is 4.8 mm; the joints are in the following proportions:

Joint	1	2	3	4	5	6	7	8-9	10	11	12	13	14
	44	52	26	26	26	26	26	52	33	37	40	48	48
	15	16	17	18	19	20	21	22	23	24	25		
	52	55	55	52	48	36	36	36	52	48	36=1000.		

The 2nd antenna has the exopodite about 1.4 times as long as the endopodite (31:23). The mandible has the exopodite as long as the endopodite; the cutting edge rather small. The 1st maxilla has 9 setae on the outer lobe, 10 setae on

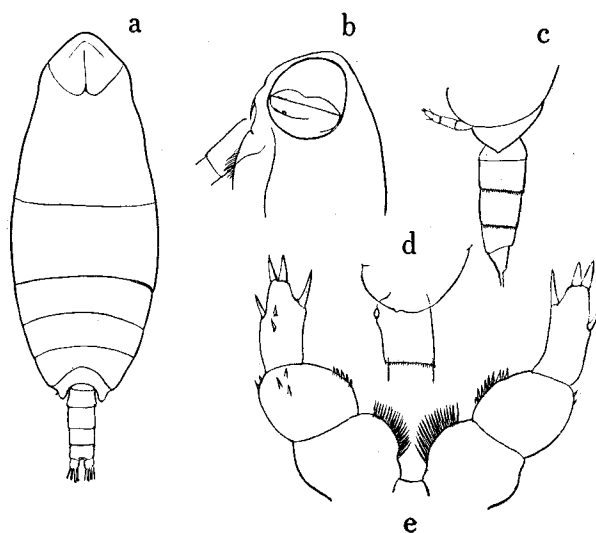


Fig. 100. *Cephalophanes frigidus* WOLFENDEN.

Immature female: a, dorsal aspect; b, head, lateral aspect; c, last thoracic segment and abdomen, lateral aspect; Female. d, last thoracic segment and genital segment, lateral aspect; e, 5th pair of legs.

the exopodite, 3+1+2 setae on the endopodite, 5 setae on the 2nd basal, 3 setae on the 2nd basal, 3 setae on the 3rd inner lobe, 2 setae on the 2nd inner lobe, 13 setae on the 1st inner lobe. The 2nd maxilla has 8 sensory appendages on the endopodite, of which the distal one is long and slender, the remainings are bud-like; the spine on the 5th lobe not so strong. The maxillipede as usual; the basal joints are of about equal lengths; the 2nd basal has groups of spinules on the anterior proximal margin.

The 1st to 4th swimming legs as those of the genus *Xanthocalanus*. The 5th pair of legs 3-jointed. The 1st joint robust, produced inwardly, and has a row of long hair-like spines, about 15 in number on the inner margin. The 2nd joint is also

robust, has small denticles on the inner margin about the middle of the joint; the right leg has, beside these marginal denticles, several small spines near the distal margin on the posterior surface. The 3rd joint has 2 apical spines and 2 marginal spines, of which the inner marginal one is longer; the posterior surface of the joint has 2 small spines on the right leg, but these spines are absent in the left leg (fig. *e*). These posterior spines are more in number in STEUER's example, whereas, FARRAN's specimen has only a single large spine instead of a group of small ones on the posterior surface of the 3rd joint of the right 5th leg.

Immature female. Length, 3.32 mm. The 5th pair of legs as in the adult female, but the spinulation on the inner margin of the 1st and 2nd joints are feeble. The specimen is in the copepodid stage V.

The abdomen composed of 4 segments. The lateral distal corner of the last thoracic segment is more pointed than in the adult female (figs. *a, b, c*).

Immature male. Length, 3.25 mm. The specimen is in the 5th copepodid stage. The abdomen 4-segmented. The lateral distal corner of the last thoracic segment sharply pointed at the apex in the present specimen, whereas, it is rounded in STEUER's specimen (STEUER, 1926, text-figs. 15-17). In other respects my specimen agrees well with his description and figures.

Remarks. The specimen reported by WOLFENDEN or STEUER has no inner marginal spine on the 3rd joint of the 5th pair of legs. FARRAN's specimen from the Antarctic has an inner marginal spine. FARRAN considered his specimen to be intermediate form between *C. refulgens* SARS and *C. frigieus* WOLFENDEN. My specimen comes nearest to FARRAN's example, of *C. frigidus*, taken from the area 66°S and 30-76°S.

Occurrence. One adult female, one immature female and one immature male from Sagami Bay in the hauls 1000-0 m, November, 1937.

Distribution. The species has been recorded from the tropical Atlantic, Indian, and Antarctic Oceans.

Family THARYBIDAE

SARS (1903) created a new tribe Isokerandria comprising 4 families, Diaxiidae, Stephidae, Tharybidae, and Pseudocylopidae. But this tribe has not been accepted by many authors and been advised to drop the tribe as a separate group on account of the fact that some of these families exhibit resemblance partly to Scolecithricidae and partly to Phaennidae. However, the family Tharybidae shows some differences in the structure of the 1st and 2nd maxillae from those of Phaennidae or Scolecithricidae. It seems better not to unite the family into Phaennidae or to Scolecithricidae, and to keep it as a separate family and place it in the neighbourhood of the family Phaennidae and Scolecithricidae.

The family Tharybidae at first comprised the genus *Tharybis* Sars, and the genus *Undinella* Sars has hitherto been comprised in the family Phaennidae. But on comparing *Undinella* with *Tharybis* we find so many common characters between them in the structure of the mandible, maxillae and swimming legs that it is advisable to refer *Undidella* to the genus Tharybidae, which is intermediate one between the families Phaennidae and Scolecithricidae. The 5th pair of legs of the genera belonging to Tharybidae is 3-jointed in the female. This is the character also found in the genera of Phaennidae. The male has the 5th pair of legs as that found in the genus *Lophothrix*, one of the genus of the family Scolecithricidae.

FLEMINGER has established the third genus *Parundinella*. The genus is characterized by its small size, the possession of an enlarged falcate spine on the 5th lobe of the 2nd maxilla, and 2-jointed 5th pair of legs in the female. The 2nd maxilla of *Parundinella* has 5 or 6 sensory filaments, of which some with apical flagellum; the 5th lobe has, beside the stout spine, 2 sensory filaments and a normal seta; this is the character found in the family Scolecithricidae, and not found in the family Phaennidae. The 5th pair of legs of the female of *Parundinella* have the general resemblance to those of the members of *Xanthocalanus* or *Scolecithricella*. The male 5th pair of legs also indicate a close relationship of the genus with *Scolecithricella* or *Scaphocalanus*. It is justified that FLEMINGER has placed the genus *Parundinella* in the family Tharybidae.

Genus *Tharybis* G. O. Sars

The genus comprised a single species *T. macrophthalma* Sars taken from the coast of Norway. According to Sars the species belongs to a bottom form. The generic characters defined by Sars as follows: eye present on dorsal face of head; mandible has a characteristic biting part; 1st maxilla has a exceedingly large 1st inner lobe; exopodite and endopodite poorly developed; 2nd maxilla has both worm-like and penicillate sensory filaments in distal segments; maxillipede with robust basals and short endopodite; swimming feet has no spinules on the posterior surface of exopodite and endopodite; 5th pair of feet 3-jointed in the female; terminal joint linear and strongly spinous at tip; in male 5th pair of feet very large and rather asymmetrical, right foot simple.

In the present collection I have been able to detect the second species which appears to be undescribed, to which I propose the name *Tharybis sagamiensis*.

Tharybis sagamiensis sp. nov.

(Fig. 101, a-h)

Female. Length, 1.20 mm: cephalothorax, 0.93 mm; abdomen, 0.27 mm. The

cephalothorax ovate and robust. The head fused with the 1st thoracic segment; the 4th and 5th thoracic segments are fused (fig. *a*). The lateral distal corner of the last thoracic segment bluntly rounded (fig. *c*). The rostral filaments fine, attached to the basal portion which projects ventrally (fig. *b*).

The abdomen 4-segmented, the segments are in the proportional lengths 43:17:17:3:20=100. The genital segment about as long as wide, slightly asym-

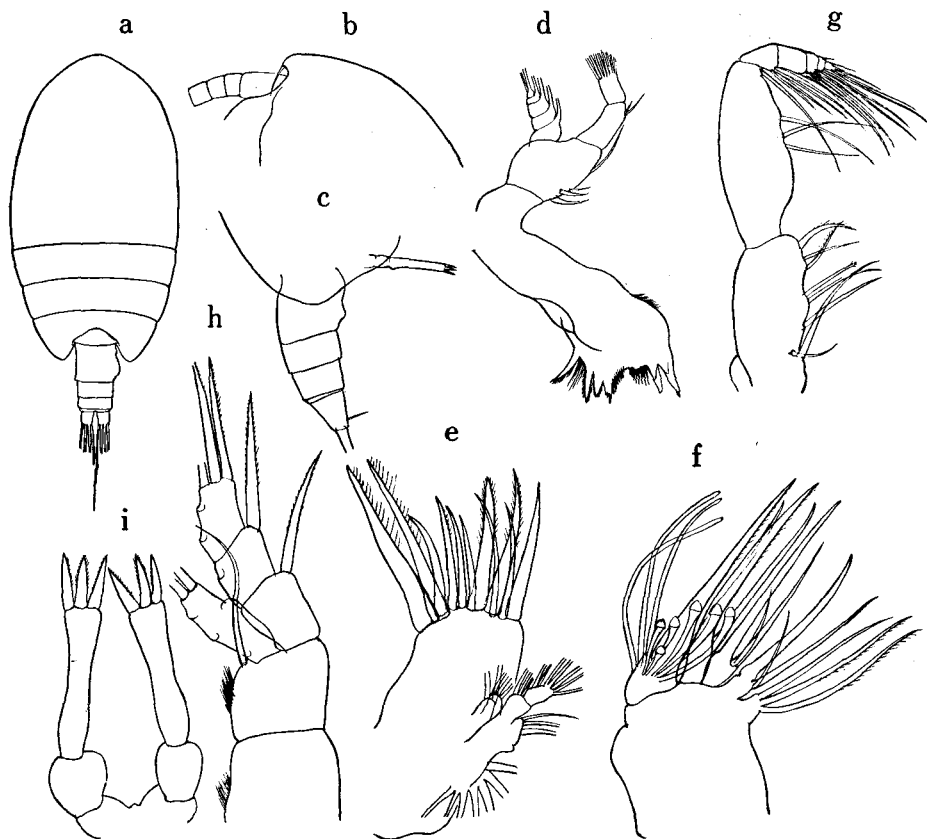


Fig. 101. *Tharybis sagamiensis* sp. nov.

Female: *a*, dorsal aspect; *b*, head, lateral aspect; *c*, last thoracic segment and abdomen, lateral aspect; *d*, 2nd antenna; *e*, 1st maxilla; *f*, 2nd maxilla; *g*, maxillipede; *h*, 1st leg; *i*, 5th pair of legs.

metrical; the lateral margin of the right side has a small swelling; the ventral surface slightly swollen below. The 2nd and 3rd segments are striated on the distal margin. The furcal rami about as long as wide.

The 1st antenna 24-jointed, reaches back to the end of the 3rd thoracic segment; the joints are in the following proportional lengths:

Joint	1	2	3	4	5	6	7	8-9	10	11	12	13	14
	74	85	32	27	27	27	27	53	32	32	37	43	43
	15	16	17	18	19	20	21	22	23	24	25		
	43	37	37	37	37	27	27	48	63	74	42=1000.		

The 2nd antenna has the exppodite 2 times as long as the endopodite; the 1st basal joint bears a tuft of hairs on the posterior surface; the distal joint of the exopodite is very long, more than half the length of the exopodite. The mandible has the exopodite shorter than the endopodite; the biting part very strong; the teeth on the inner margin are furnished with stiff hairs (fig. *d*). The 1st maxilla has an exceedingly large masticatory lobe; the exopodite and endopodite are feeble; the outer lobe has 7 setae; the 2nd and 3rd inner lobes have each 2 and 3 setae respectively (fig. *e*). The 2nd maxilla has 3 long worm-like filaments and 6 bud-like sensory filaments on the distal joints; the spine on the 5th lobe is stout but not long. In the maxillipede the 1st basal joint carries a sensory filament on the 3rd lobe; the 2nd basal joint is robust (fig. *f*). The basal joints robust (fig. *g*).

The 1st leg has 3-jointed exopodite and 1-jointed endopodite; the outer edge spines on the joints of the exopodite very long (fig. *h*). The 2nd leg has 3-jointed exopodite and 2-jointed endopodite; the distal joint of the exopodite has 4 inner marginal setae. The 3rd and 4th legs have each 3-jointed exopodite and endopodite. The posterior surface of the exopodite and endopodite of the 2nd to 4th legs are devoid of spinules.

The 5th pair of legs 3-jointed; the 3rd joint long, carries 3 apical spines and a small triangular process near the proximal margin of the posterior surface when viewed from the lateral (fig. *i*, fig. *c*).

Remarks. The specimen very closely resembles *T. macrophthalma* Sars in the structure of the mouth parts and swimming legs but can be distinguished from it by the shape of the genital segment and the structure of the 1st and 5th pair of legs.

Occurrence. One female from Sagami Bay in the vertical haul from 1000-0 m, November, 1937.

Genus *Undinella* G. O. Sars

Sars (1900) created the genus to include a small Calanoida, *Undinella oblonga*, obtained in the Norwegian North Polar Expedition. Wolfenden (1906) described the 2nd species *Undinella simplex*, which is afterwards redescribed by Farran (1908) under the name *Undinella brevipes*. In the earlier period of my collection I have recorded a form closely related to the present genus under the name *Paratharybis frontalis* which should properly be referred to the genus *Undinella*. In addition to the species described, I have been able to detect other 3 species,

of which one appears to be undescribed to which I give the name *Undinella spinifer*.

The genus has been comprised in the family Phaennidae, and closely related to the members of the genus *Xanthocalanus*, yet differs from them in the 2nd antenna, mandible, maxillae, swimming legs, and also in the male 5th pair of legs. The genus differs also from *Tharybis* in less robust body, in the structure of the rostrum, in the sensory filaments of the 2nd maxilla, and in the slender maxillipede.

Undinella oblonga Sars

(Fig. 102, a-e)

Undinella oblonga, VAN BREEMEN, 1908, p. 68, figs. 5-9; FARRAN, 1908, p. 50; JESPERSEN, 1934, p. 85; BRODSKY, 1950, p. 276, fig. 186.

Female. Length, 2.56 mm: cephalothorax, 1.81 mm; abdomen, 0.75 mm. The abdomen is contained 2.4 times in the length of the cephalothorax. The cephalo-

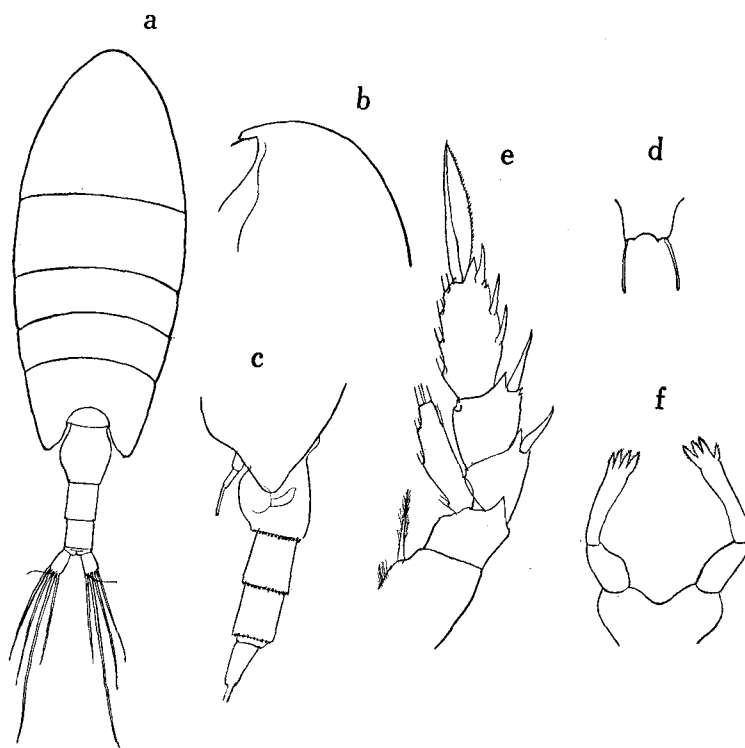


Fig. 102. *Undinella oblonga* Sars.

Female: a, dorsal aspect; b, head, lateral aspect; c, last thoracic segment and abdomen, lateral aspect; d, rostrum, anterior aspect; e, 2nd leg; f, 5th pair of legs.

thorax elongate ovate. The head separates from the 1st thoracic segment; the last 2 thoracic segments are completely fused. The frontal margin of the head contracted (fig. *a*). The lateral distal corner of the last thoracic segment produced triangularly with a rounded tip (fig. *c*). The rostrum has 2 aesthetasque-like filaments attached to the basal part which is hollowed at the apex (figs. *b*, *d*).

The abdomen 4-segmented, the segments and furca in the proportional lengths $33:24:21:5:17=100$. The genital segment swollen laterally, about as long as wide. The anal segment short. The furcal rami 1.75 times as long as wide.

The 1st antenna 24-jointed, extends to the distal margin of the genital segment. The mouth parts and the 1st to 4th swimming legs as described by previous authors. In the 2nd leg the 1st and 2nd joints of the endopodite are incompletely fused (fig. *e*).

The 5th pair of legs 3-jointed, the 3rd joint has 4 spines of about equal lengths on the distal margin (fig. *f*).

Remarks. Sars' specimen from the Antarctic measured 3.00 mm.

Occurrence. One female from Suruga Bay in the vertical haul 1260-0 m, December, 1937.

Distribution. The species has been recorded from the waters between East Greenland and Spitzbergen, the Norwegian Sea, Irish Atlantic Slope, Baffin and Davis Strait. The species appears to be an Arctic form.

Undinella brevipes FARRAN

(Fig. 103, *a-f*)

Undinella simplex, WOLFENDEN, 1906, p. 30, pl. 10; *Undinella brevipes*, FARRAN, 1908, p. 50, figs. 1-4; VERVOORT, 1957, p. 95.

Immature male in the copepodid stage V. Length, 1.34 mm. The abdomen is contained 2.6 times in the length of the cephalothorax. The body oblong ovate. The head separates from the 1st thoracic segment; the 4th and 5th thoracic segments are separate (fig. *a*). The lateral distal corner of the last thoracic segment is produced into an acute point (fig. *c*). The rostrum hollowed at the apex, with 2 slender filaments attached to the distal end (figs. *b*, *d*).

The abdomen 4-segmented. The 1st antenna 24-jointed, reaches back about to the end of the 3rd thoracic segment; the joints 8 and 9 are fused. The 1st maxilla reduced, with 4 setae on the exopodite (fig. *e*). The other mouth parts as described by FARRAN.

The 5th pair of legs undeveloped, asymmetrical; the exopodite and endopodite 1-jointed; the exopodite of the right leg longer than that of the left; the endopodite of the right leg small (fig. *f*).

Remarks. Acute distal margins of the last thoracic segment are the charac-

teristic which separate the present species from the other members of the genus. The adult female recorded by FARRAN measured 1.60 mm in total length, and has the last thoracic segment completely fused with the preceding.

Occurrence. One immature female from Sagami Bay from 1000-0 m, November, 1937.

Distribution. The species has been recorded from the North Atlantic.

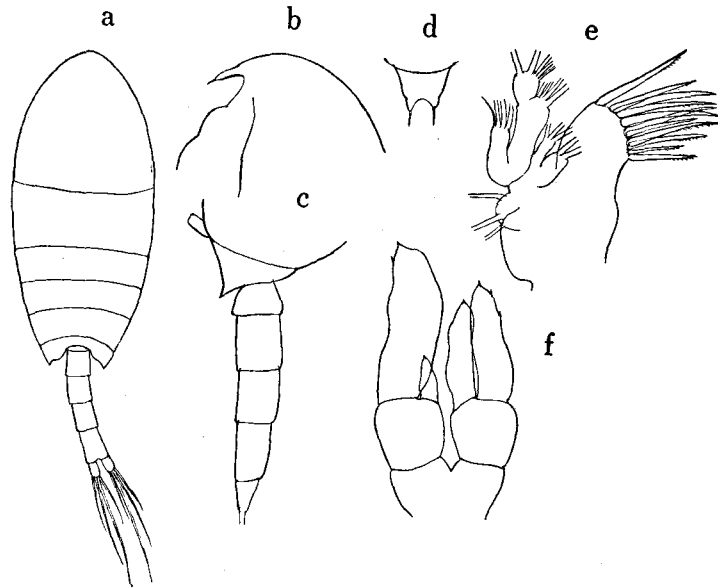


Fig. 103. *Undinella brevipes* FARRAN.

Immature male: *a*, dorsal aspect; *b*, head, lateral aspect; *c*, last thoracic segment and abdomen, lateral aspect; *d*, rostrum, anterior aspect; *e*, 1st maxilla; *f*, 5th pair of legs.

Undinella spinifer sp. nov.

(Fig. 104, *a-h*)

Female. Length, 2.78 mm. Cephalothorax, 2.03 mm; abdomen, 0.75 mm. The abdomen is contained 3.7 times in the length of the cephalothorax. The cephalothorax ovate in dorsal view. The head separates from the 1st thoracic segment; the 4th and 5th thoracic segments are fused (fig. *a*). The lateral distal corner of the last thoracic segment is produced into an acute angle and terminates into point (fig. *c*). The rostral filaments slender attached to the basal part which is concave at the apex (figs. *b*, *d*).

The abdomen 4-segmented; the segments and furca in the proportions 36:24:21:5:14=100. The genital segment about as long as wide, not swollen

below. The anal segment short, concealed beneath the foregoing. The furcal rami 1.5 times as long as wide.

The 1st antenna 24-jointed, extends about to the posterior margin of the last thoracic segment; the joints are in the following proportions:

Joint	1	2	3	4	5	6	7	8-9	10	11	12	13	14
	69	77	26	17	17	17	17	34	30	30	34	43	43
	15	16	17	18	19	20	21	22	23	24	25		
	52	55	52	52	55	52	43	47	52	52	34=1000.		

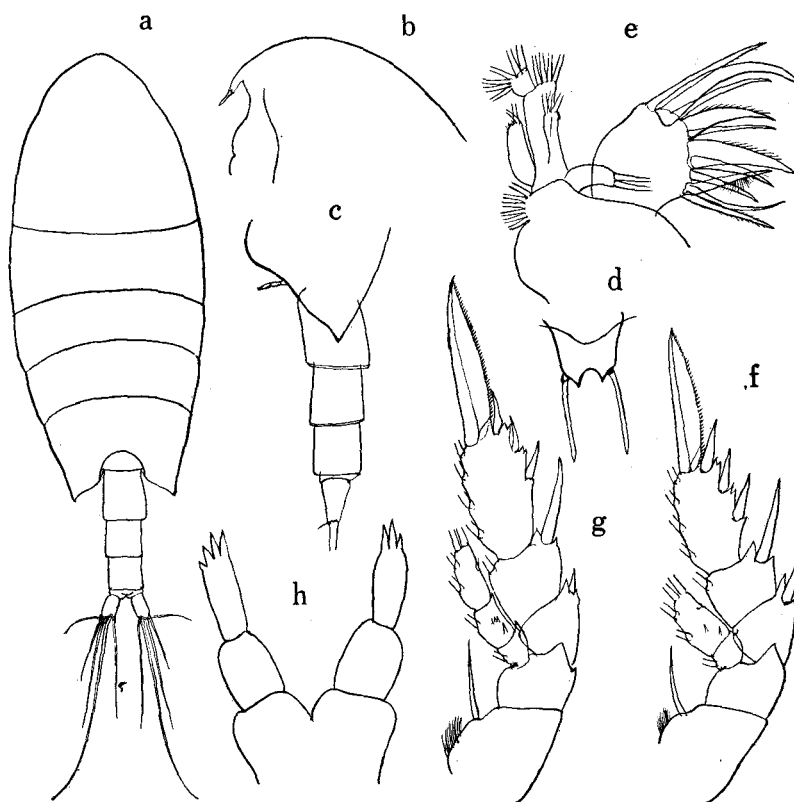


Fig. 104. *Undinella spinifer* sp. nov.

Female: *a*, dorsal aspect; *b*, head, lateral aspect; *c*, last thoracic segment and abdomen, lateral aspect; *d*, rostrum, anterior aspect; *e*, 1st maxilla; *f*, 2nd leg; *g*, 3rd leg; *h*, 5th pair of legs.

The mouth parts as those of the other members of the genus. The spines on the 1st inner lobe of the 1st maxilla are very strong (fig. *e*).

The 1st leg has 3-jointed exopodite and 1-jointed endopodite. The 2nd leg has 3-jointed exopodite and 2-jointed endopodite; the outer edge spine on the

2nd joint of the exopodite long; the 2nd joint of the endopodite has 2 spinules on the posterior surface; the terminal spine of the exopodite has about 50 teeth (fig. *f*). The 3rd and 4th legs have each 3-jointed exopodite and endopodite. In the 3rd leg the 2nd joint of the endopodite has spinules on the posterior surface (fig. *g*). The 2nd basal joint of the 2nd to 4th legs has each very minute spinules on the inner distal corner at the base of the endopodite.

The 5th pair of legs 3-jointed, asymmetrical; the joints are of about equal lengths; the right leg has 4 apical spines, and the left leg has 3 spines on the distal margin (fig. *h*).

Remarks. The present species is closely resembles *U. oblonga* Sars, but can be distinguished from it by the shape of the genital segment and by the short and stout 5th pair of legs.

Occurrence. 2 females from Suruga Bay in the vertical haul 1000-0 m, December, 1937.

Undinella frontalis (TANAKA)

(Fig. 105, *a-f*)

Paratharybis frontalis, TANAKA, 1937, p. 264, fig. 13, a-c, pl. 19, figs. 1-13. (female); *Undinella frontalis* BRODSKY, 1950, p. 277, figs. 188, 189; VERVOORT, 1957, p. 96.

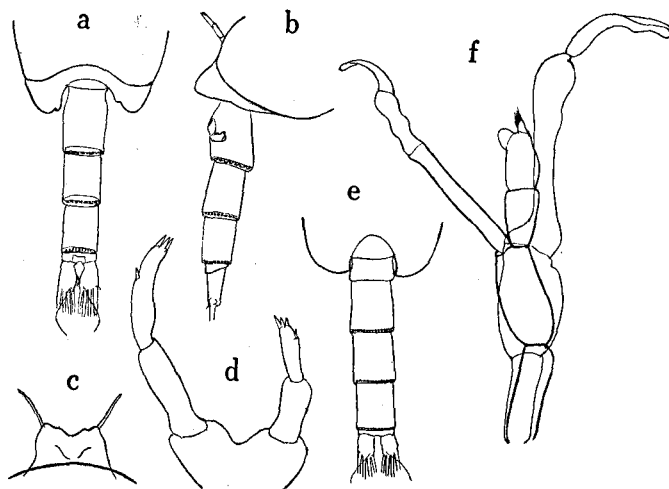


Fig. 105. *Undinella frontalis* (TANAKA).

Female: *a*, thoracic segments and abdomen, dorsal aspect; *b*, thoracic segments and abdomen, lateral aspect; *c*, rostrum, anterior aspect; *d*, 5th pair of legs. Male: *e*, last thoracic segment and abdomen, dorsal aspect; *f*, 5th pair of legs.

Male. Length, 1.95 mm: cephalothorax, 1.41 mm; abdomen, 0.54 mm. General appearance as in the female (figs. *a-d*). The body elongate ovate. The head separates from the 1st thoracic segment. The last 2 thoracic segments are fused. The last thoracic segment symmetrical; the lateral distal corner boldly rounded (fig. *e*). The rostral filaments slender, about as long as the basal part which is concave at the apex.

The abdominal segments and furca in the proportions 12:26:26:23:2:11=100. The furcal rami 1.5 times as long as wide. The 2nd to 4th segments are finely striated on the distal margin.

The 1st antenna 24-jointed, reaches back to the end of the anal segment; the joints 9 and 10 are partially fused; the joints 20 and 21 are completely fused on the right side, but they are separate on the left side.

The mouth parts and 1st to 4th swimming legs as those of the female.

The 5th pair of legs long, extends, when reflexed, beyond the distal margin of the furca. In the right leg the 2nd basal joint voluminous; the exopodite 2-jointed, the endopodite absent. The left leg has 3-jointed exopodite and endopodite; the endopodite long and slender; the exopodite is about half as long as the endopodite; the 2nd joint of the exopodite is furnished with a large protuberance on the inner distal margin; the 3rd joint of the exopodite small, carries stiff hairs on the inner distal margin (fig. *f*).

Remarks. The female has been described under the name *Paratharybis frontalis* by the specimen taken from Suruga Bay from the depth 500-250 m, June, 1936. The female specimen measured 2.21 mm.

Occurrence. 3 females and one male from Sagami Bay in the haul 1000-0 m. November, 1937. BRODSKY's male specimen measured 1.7 mm. VERVOORT reports that this rare form also occurred in the "Snellius" collection.

Distribution. The species has been recorded from the Far Eastern and Polar Seas of the U.S.S.R. and the eastern part of the East Indies.